Escape from Cuba

AIR&SPACE

Smithsonian•December 1993/January 1994

THE COLDEST WAR

Why the Air Force Wanted Missiles on the Moon

Surviving the Crash of Eastern

$3.50 U.S./$4.50 Canada

0 73361 64757 3 12

Paul DiMare

When's The Last Time You Actually Looked Forward To Stopping At A Red Light?

If you always thought that waiting for the light to change was a rather dull experience, then you've never been behind the wheel of a Jeep Grand Cherokee Limited.

As the most advanced 4x4 we've ever built, it has the ability to transform ordinary driving experiences into extraordinary ones. With features like the Quadra-Trac® all-the-time four-wheel drive system, standard

our-wheel anti-lock brakes, Quadra-Coil™ suspension, and the only V8 available in its class.

To learn more about Jeep Grand Cherokee Limited, please call 1-800-JEEP-EAGLE. Or stop by your local Jeep and Eagle dealer.

And prepare to see the light.

There's Only One Jeep®...

A Division of the Chrysler Corporation.

Jeep

Eagle

ee limited warranties, restrictions, and details at dealer. Always wear your seat belt.

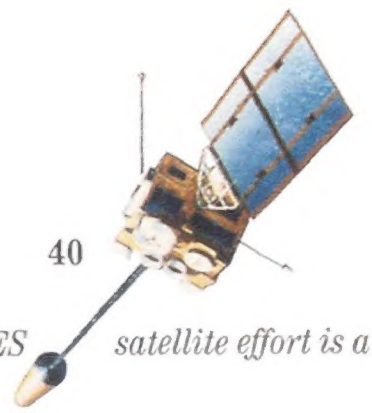
Jeep is a registered trademark of Chrysler Corporation.

December 1993/January 1994
Volume 8, Number 5

AIR&SPACE

Smithsonian

CONTENTS



Cover:
Artist Paul DiMare created a vision of the moon as it might have been.

AIR & SPACE/Smithsonian (ISSN 0886-2257) is published bimonthly by the Smithsonian Institution, 900 Jefferson Drive, Washington, DC 20560. Subscription price: $18 a year in U.S. possessions, $24 elsewhere. Eighty-five percent of dues is designated for magazine subscriptions. Single-copy price: $3.50. Second-class postage paid at Washington, DC, and additional entry points. Editorial offices: 370 L'Enfant Promenade SW, 10th Floor, Washington, DC 20024. Advertising and circulation offices: 420 Lexington Ave., New York, NY 10170. Members: Address all subscription correspondence and change-of-address information to P.O. Box 53261, Boulder, CO 80322-3261. Postmaster: Send address changes to *AIR & SPACE/Smithsonian*, P.O. Box 53261, Boulder, CO 80322-3261.

PRINTED IN THE USA

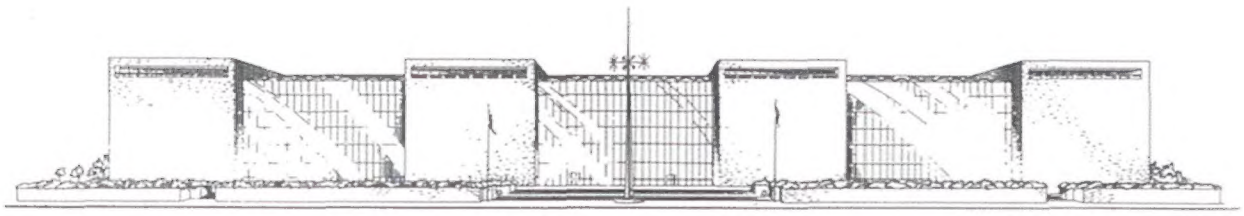
Give her your closest shave. The new Norelco.

With the new Norelco shaving groove to help move your beard closer, our "Lift and Cut"™ system can shave substantially closer.

Comfortably.

Still, the most exciting thing about our new Norelco isn't what happens while you shave, but after.

The New Norelco® Razors. Our Closest Shave. Ever.



An Endless Frontier?

Half a century ago, as World War II was coming to a close, Vannevar Bush, wartime head of the Office of Scientific Research and Development, submitted a report, *Science, The Endless Frontier*, to President Truman. Bush urged the establishment of what was to be the National Science Foundation, arguing: "On the wisdom with which we bring science to bear against the problems of the coming years depends in large measure our future as a Nation."

That boundless confidence in the promise of science and technology has, ever since, been reflected in national funding for research and development, in school science curricula, and in museum displays on advances in technology.

In recent years, however, a malaise has set in. The cost of science and the number of scientists produced have become unaffordable. Megaprojects and whole cadres of the nation's leading researchers wait in line for decades hoping that Congress will give them the go-ahead and necessary funding.

As this glut has reached crisis proportions, the prestigious National Academy of Sciences, National Academy of Engineering, and Institute of Medicine have recently joined forces in producing *Science, Technology and the Federal Government: National Goals for a New Era*—a sequel to Vannevar Bush's report.

Where Bush had a clear vision for the future, the new report finds no easy road ahead. It does suggest that the federal government select for funding only those projects that clearly are in the nation's interest, as judged by panels of leading scientists and engineers selected for their competence and vision. It also proposes that industry investment in a project be a criterion for its federal funding—a measure that would indicate a project's commercial promise.

Sensible as these recommendations appear, one is struck by the thought that, by these criteria, space station Freedom might not have become a national priority. Commercial investments in microgravity projects proposed for the station have been limited, and most scientists, when contemplating the station, see few applications that could not be accomplished less expensively by other means. The space station is widely considered to be necessary primarily to test man's ability to endure in space, an issue of consequence if the nation has a long-term interest in colonizing space. Unfortunately, that interest has never been explicitly stated, though perhaps it should be.

The committee's report does, however, make strikingly clear how national priorities for science and technology have increasingly become tied to political and economic conditions and social pressures. This suggests, though the report does not make the point, that scientists and engineers should be trained to have significantly broader understanding of economic issues, while economists and lawmakers should somehow become far more aware of the workings and capacities of science and technology.

The need for such broad understanding is pressing. I have just come across an essay by the late I.I. Rabi, a Nobel laureate by the time of the Manhattan Project. Writing in a book commemorating the 40th anniversary of the Los Alamos National Laboratory, decades after the construction of the atomic bomb, he opined, "Although we meant well, we abdicated. We gave it away. We gave the power to people who didn't understand it and who were not grown up and responsible enough to realize what they had."

That may sound naive, but it came from one of this country's great scientists, and is symptomatic of a clear need for greater enlightenment.

We at the National Air and Space Museum can serve a useful purpose by exhibiting the ways science and technology have shaped the economy in the past and how we, as a nation, can rationally plan our future.

—Martin Harwit is the director of the National Air and Space Museum.

AIR&SPACE
Smithsonian

Secretary of the Smithsonian Institution
Robert McC. Adams

Editor
George C. Larson

Managing Editor
Tom Huntington

Senior Editor
Linda Musser Shiner

Departments Editor
Patricia Trenner

Senior Associate Editor
Perry Turner

Associate Editors
Karen Jensen
David Savold
Diane Tedeschi

Photography/Illustration
Caroline Sheen

Design Consultation
Phil Jordan
Julie Schieber

Publisher
Ronald C. Walker
Mary D. Haskin, Assistant

Administration
Carey O. Randall, Associate Publisher

Advertising
Louis C. Kolenda, Director

Circulation
Gale Page, Director
Margaret Moore
Paula J. de Brito

Production
Sarah D. Kingsley, Manager
Kristine L. Roberts

Business
Shelia Perry Brannum, Manager

Founder
Walter J. Boyne

Publisher Emeritus
Joseph J. Bonsignore

THE MOST POWERFUL COMPACT RADIO IN THE WORLD!

First and ONLY world band with award-winning vertical design. Measures approximately 7⅛" x 4½" x 1⅝", with built-in stand and retractable ferrite antenna.

THE GRUNDIG YB-500
FM/AM Shortwave Receiver

Listen! Here is the BIG BREAKTHROUGH in powerful performance and design. And only Willabee & Ward has it in the USA. No other compact radio in the world packs all these powerful features.

▲ POWERFUL RECEPTION. The Grundig YB-500 **does it all:** pulls in AM, FM, FM stereo, **every** SHORTWAVE band, even aviation, military and ship-to-shore. All with lock-on digital precision.

▲ POWERFUL SOUND. Exclusive Audio Power Boost — found on no other world band radio — gives the YB-500 big, rich, room-filling legendary Grundig sound.

Powerful Features.

Power scan! The YB-500 has continuous power scan on shortwave — stops at every signal and lets you listen. When you hear a broadcast you want, you tell the radio to stop. Only Grundig has this feature.

Power timing features! The YB-500 can send you to sleep on FM, wake you with weather on AM, then switch you to BBC shortwave. Even shuts itself off. Elsewhere, you'd pay $500 for these features.

Powerful Memory.

The BBC and *all* major world broadcasters are pre-set for instant retrieval. You can add 40 more stations on any band and display call letters for reference. No other radio at this price offers such powerful memory.

Also has instant keypad access to all frequencies. Illuminated, adjustable LED display for bedside use. Advanced RDS FM station information display. It will be years before other makers catch up with the YB-500. Available today only from Willabee & Ward.

Powerful Value.

The Grundig YB-500 is only $299 (plus $9.50 shipping and handling), payable in eight monthly credit card installments of $38.56. Includes 4 AA batteries, deluxe travel pouch, stereo headphones, owner's manual, and Grundig's shortwave listening guide. INTRODUCTORY OFFER: ORDER NOW AND GET A FREE DUAL-VOLTAGE INTERNATIONAL ADAPTER!

Grundig 1-year warranty on parts and labor. 30-day money back guarantee. Grundig is to radios what BMW and Mercedes are to cars. European look! European sound! European quality! Order now!

Phone orders normally shipped next business day.

Call Toll-Free: 1-800-367-4534
Extension 697-126

RESERVATION APPLICATION

Willabee & Ward
47 Richards Avenue • Norwalk, CT 06857

Call Toll-Free: 1-800-367-4534
Extension 697-126

Please send me _____ Grundig YB-500 Digital All-Band Shortwave Receiver(s). For each receiver, charge eight installments of $38.56* to my credit card:
☐ VISA ☐ MasterCard ☐ Discover ☐ Am. Ex.

_____
Credit Card No. Exp. Date

Name _____
Please Print Clearly.

Address _____

City _____

State/Zip _____

Signature _____
(Orders subject to acceptance.)

☐ I prefer not to pay by credit card and will pay by check. Enclosed is my check for $299 plus $9.50 shipping/handling, a total of $308.50* for each receiver.

**Any applicable sales tax will be billed with shipment. Higher shipping/handling outside U.S.*

LETTERS

More Mars Tales

I read "Dan McIvor's Mars Mission" (October/November 1993) with great interest. As a young sailor who needed to go from the hospital at Pearl Harbor to Oaknoll Hospital in Oakland, California, in 1946, I had the good fortune to fly aboard the *Marianas Mars*. There were 120 patients on the flight, plus medical personnel and flight crew. The airplane was equipped with 100 bunks; I was one of 20 who sat in metal bucket seats. Cabin heat must have been supplied by manifold, as one of the ducts vented below my seat. I alternately roasted and froze.

We left Hawaii in the afternoon and arrived at Alameda about 10 a.m. the next day. During the trip, the crew proudly showed some of us various features of the craft, such as a small machine shop/work area and catwalks that provided access to the engines. I also recall that the toilets were in the huge vertical fin or stabilizer.

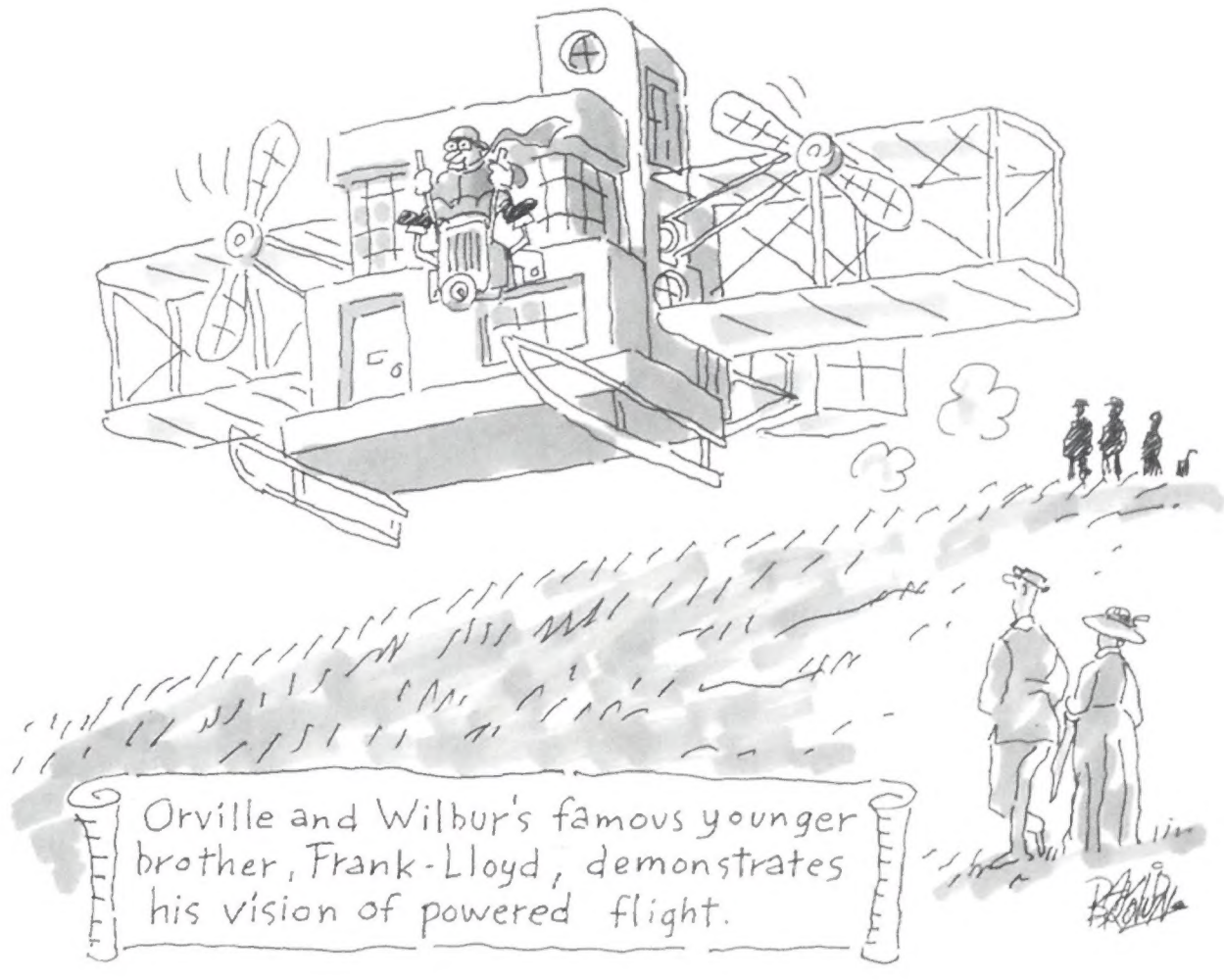
I'm sorry to hear of the destruction of the *Marianas Mars*, but I'm happy to know some of these beautiful birds are still performing useful service.

—William H. Kruse
Greeley, Colorado

"Dan McIvor's Mars Mission" stirred a great memory for us. A few years ago we were sailing just south of Nanaimo, British Columbia. It had been a very dry summer. When we looked over at Vancouver Island we spotted a growing plume of blue smoke.

Within minutes a helicopter came into view, circled the smoke, then departed. Soon a fixed-wing aircraft, a DC-4 or converted C-54, flew over and made a pass at the fire. Then *they* arrived—two huge red birds.

What a thrill to be only about a hundred yards away as the Mars made



Give your family a gift they'll really appreciate:

A lifetime of health.

In just minutes a day, NordicTrack gives them a healthier life.

Give your family the best way to improve their health and fitness. The efficient NordicTrack workout takes as few as 20 minutes, 3 times a week to control weight, build cardiovascular fitness, reduce stress, strengthen and tone the entire body. A NordicTrack® exerciser is the gift that gives your family a better life — wives, husbands, brothers, sisters and grandparents alike.

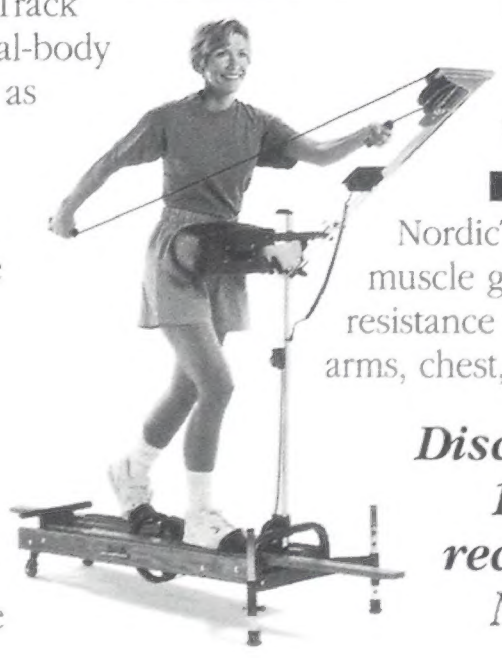
Give them "The World's Best Aerobic Exerciser®."

Health experts call cross-country skiing the world's best aerobic workout. NordicTrack simulates that workout with a smooth total-body motion no other exerciser can match. It's as easy as walking.

Our *patented flywheel and one-way clutch system* offers a workout that won't jar the back, strain the knees or stress the ankles. As soon as they start exercising, they'll feel the NordicTrack difference.

It's the gift they'll use.

NordicTrack is one gift that won't collect dust. Recent studies show that even after five years, 7 in 10 owners use their NordicTrack an average of three times a week for over 20 minutes.



■ **Take weight off.**
Our vigorous total-body workout burns incredible amounts of calories — up to 1,100 per hour according to research.

■ **And help keep the weight off.**
NordicTrack burns up to 36% more fat than with exercise bikes — and more than stairstepping or jogging. Regular workouts with NordicTrack can make the difference. In fact, research shows that 8 in 10 people who bought a NordicTrack to lose weight lost an average of 17 pounds. And after one year, they still kept it off!

■ **Protect them from stress.**
By quickly building cardiovascular fitness, NordicTrack will help reduce stress felt at home or work. And help them handle stress when it turns up.

■ **Tone their total body.**
NordicTrack tones all the body's major muscle groups. Simply set the adjustable resistance to help firm and shape the legs, arms, chest, back, buttocks and stomach.

Discover the gift that over 1.5 million people have received — a life-enriching NordicTrack workout.

Call now:

1-800-441-7891 *Ext. 11313*

Call NordicTrack today for more information!

30-day in-home trial!

NordicTrack
A CML Company

We're Changing the Shape of America™

FREE Information

❑ *Please send me a FREE brochure*
❑ *Also a FREE VHS videotape*

Name _____ Phone ( ) _____

Street _____

City _____ State _____ Zip _____

Send to: NordicTrack, Dept. 11313, 104 Peavey Road, Chaska, MN 55318-2355

their incredibly precise landings, their engines revving as the pilots advanced the throttles on touching down to scoop up water.

They established a pattern, one scooping while the other dropped its load of water on the fire. After each had made a dozen or so passes, the fire was out, the smoke now wisps of white. And then, just as grandly as they had arrived, they flew away, having saved the forest.

What a performance! No one could have had a better ringside seat for such a marvelous airshow.

—Col. George S. and Olive Anderson
Sequim, Washington

A Notable Omission

John M. Logsdon's essay about the space station ("For All Who Share Our Goals," October/November 1993) is a good analysis of space funding and the complex global political issues that are involved.

It is unfortunate, however, that Logsdon didn't include a single line explaining why we need a space station in the first place.

—William G. Jensen
Tulsa, Oklahoma

The Birth of the X-1

Jeffrey L. Ethell's fine article "At the Threshold of Space" (October/November 1993) credits Robert J. Woods as the designer of the Bell X-1. It's true that Woods was chief of preliminary design, and that an informal meeting he had with Major Ezra Kotcher at Wright Field resulted in Bell's receiving the design-development contract. Woods also made some rough configuration sketches and weight estimates on the train back to the plant. But the actual preliminary design was produced by Benson Hamlin. Because Woods and Hamlin had serious differences in design philosophy, Woods was reassigned to other duties, while Hamlin, working with a small cadre of

engineering specialists, defined all the design parameters that were incorporated in the detail design resulting in the X-1. Hamlin and his team completed the task in approximately 90 days. Last summer the American Institute of Aeronautics and Astronautics honored that feat by bestowing on Hamlin its 1993 Aircraft Design Award.

—Dexter Rosen
Williamsville, New York

Milt Thompson and Me

It was with great regret that I read of the passing of former test pilot Milton O. Thompson (Soundings, October/November 1993). While he found fame as a test pilot during the pioneering days of spaceflight, he was not too important or busy to write to a young aviation buff and aspiring writer.

When I was in grade school, I built models of the X-15, the X-3, and the Grumman F9F Cougar with China Lake test markings. I watched all the Mercury launches and devoured every article on the space program I could find. I still have the magazine *Countdown* with artist's conceptions of the X-20 Dyna-Soar in a coat of sinister black with "U.S.A.F." lettered on it. I sent a dozen letters to engineers, historians, and former pilots, including one to Thompson requesting information on his role in the Dyna-Soar project. He was the first to reply, surprising me with a phone call that lasted nearly half an hour.

Later, when I was researching the history of the wingless lifting bodies, Thompson again was the first to respond to my inquiries, supplying information and photos. He even took the trouble to print stills from his own motion picture footage when suitable stills were unavailable.

It was satisfying to see Thompson make the cover of *Air & Space/Smithsonian*, as well as the story on test pilots ("Fast Track," June/July 1993). Obviously, he was also generous with the time that he gave to journalists and photographers.

Thanks for the memories, Milt. You

UNIDENTIFIED FLYING OBJECT

Can you identify the aircraft in this photograph? From time to time the National Air and Space Museum receives photographs of objects that its archivists cannot identify. This picture was once made into a postcard. Though the aircraft appears to be a small flying boat, in fact it has wheels (one can be seen behind the legs of the man holding the hat). The identities of the men are not known. On the original you can make out a policeman in the background at the far left; his uniform suggests that the locale is Europe, possibly Germany. If you can solve the mystery, write to: Letters, Air & Space/Smithsonian, *370 L'Enfant Promenade SW, 10th Floor, Washington, DC 20024. Please type or print clearly, and include your daytime phone number.*

Last issue's UFO was correctly identified by Jack McRae, Doug Rounds, Vincent Goeres, and, writing on behalf of the Antique Airplane Association, Robert L. Taylor. All four submitted material from 1929 publications that clearly show the airplane to be Fleetcraft Airplane Corporation's Model A (not to be confused with a Fleet biplane). Many readers noted that the UFO bore a strong resemblance to the Arrow Sport. The Sport and the Model A were, in a sense, cousins: Fleetcraft's president, J.B. Moore, had earlier served as Arrow Airplane & Motors Corporation's vice president, chief engineer, and production manager.

have passed the torch on to a new generation of test pilots. You will be missed.

—Jim Hunter
Renton, Washington

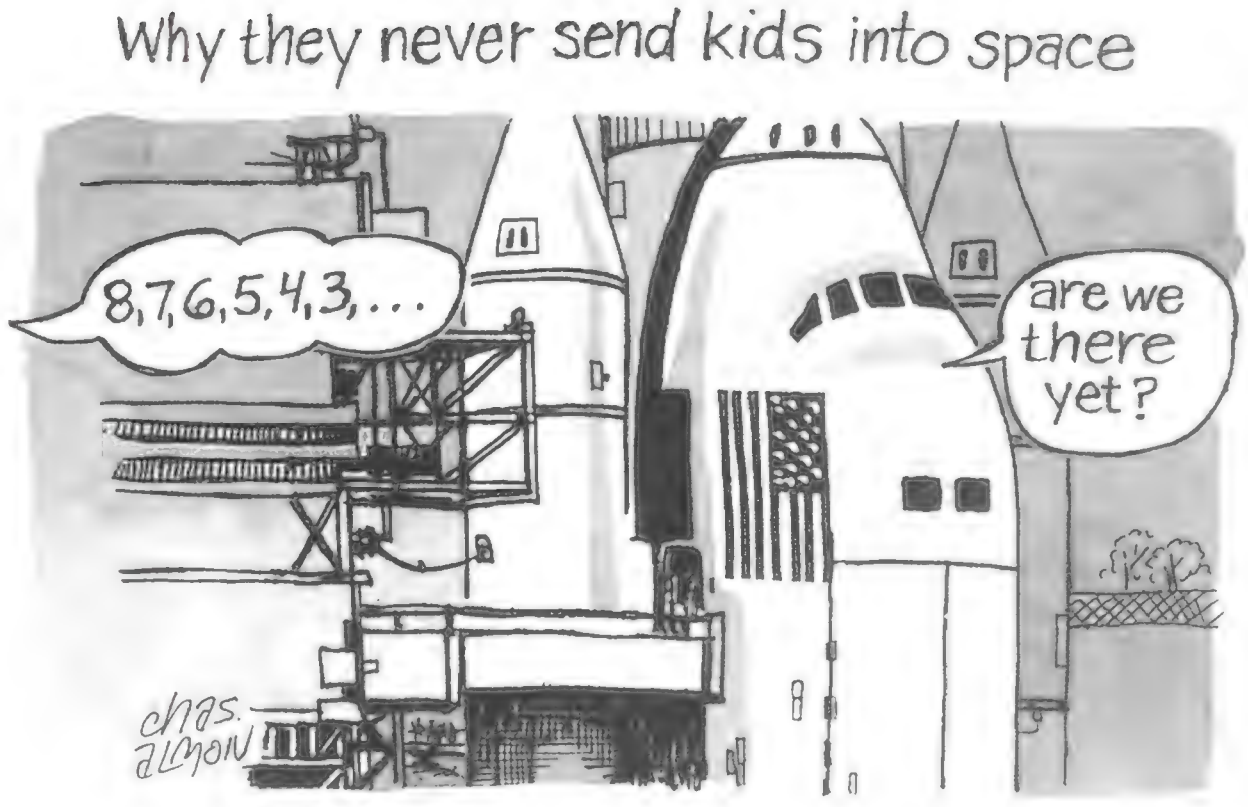
Editors' note: Milt Thompson admirers should be sure to read this issue's Flights & Fancy (p. 26).

"Beyond Aeronautics"—Too Far Out?

As one who has spent his career in both aeronautics and space, I read Guy Pignolet's essay ("Beyond Aeronautics," August/September 1993) with some interest. The arguments against the shuttle, the National Aerospace Plane, etc., are fallacious. The reason for wings on a spaceship are many, not the least of which is to enable human beings to land with dignity at 1 G so that they can go and come from space without enduring the rigors of high-G launch and entry. A reusable spaceship such as the shuttle is and will be for many years the optimum vehicle for low-Earth-orbit activities.

Mr. Pignolet's ideas of space education are somewhat unusual, to say the least. From my experience, I believe that in the university years, mastering the fundamentals of engineering, which are the basis of a curriculum in aeronautical or any other kind of engineering, is far more important than becoming a specialist in some field. Spaceflight does require a broad knowledge of almost every phase of science. However, being an expert in some endeavor is, in my opinion, a prerequisite to a career in any field because it forces one to recognize what it takes to really get the job done. Early in my career I found that criticizing someone else's work was the easiest job around.

Finally, his discussion of the solar satellites that I, Peter Glaser, and others



LETTERS

espoused shows that Mr. Pignolet has not read about or studied the problem. I am forwarding him a copy of a lecture that I presented in 1979 on the subject; he might find that getting energy from space is still a good idea. I, like him, look forward to the day when going back to the moon, traveling to Mars, and even exploring Alpha Centauri is close at hand, but alas, I suppose he has never heard of the Office of Management and Budget.

—Christopher Kraft
Houston, Texas

[Kraft was the director of NASA's Johnson Space Center from 1972 to 1982.]

Guy Pignolet responds: I am not quite sure what it means to land with dignity, but being a seasoned engineer, I fully share most of Mr. Kraft's views, whether on reusable spacecraft, the fundamentals of engineering, or the problems with various offices of management and budget around our world. I just look at these things from different perspectives.

Concerning solar power satellites, I also agree that getting energy from space is a good idea. In 1991, I, along with Peter Glaser and others, organized a cartoon contest to popularize broader SPS concepts among the youth of many countries.

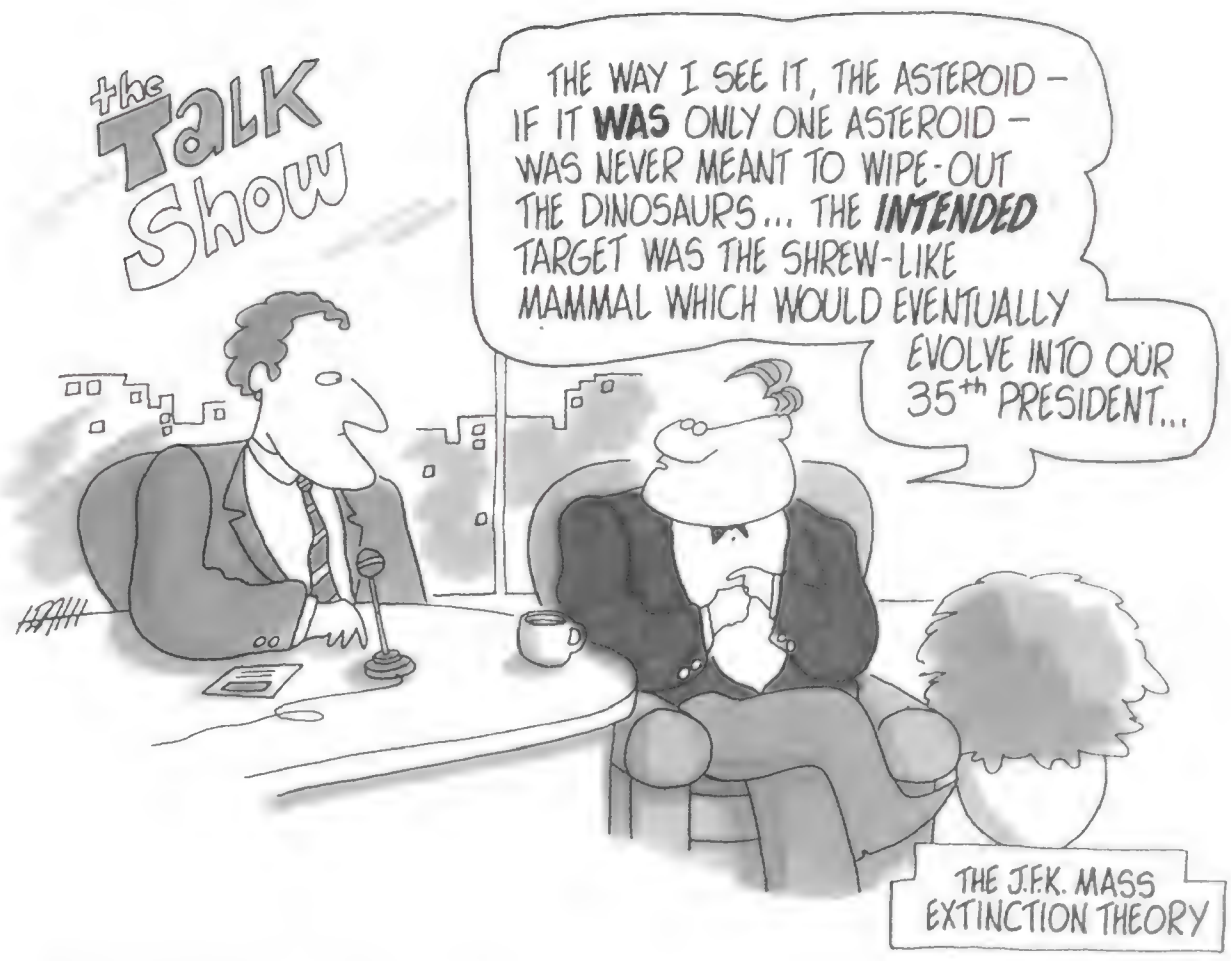
Mr. Kraft's 1979 paper on the subject did a great job on many grounds; it was a real starter, and very comprehensive. However, I read it carefully and found no mention of possible moon operations. It wasn't until a few years later that Gregg Maryniak and others from the Space Studies Institute showed that if SPSs were manufactured out of lunar material, instead of materials from Earth, as had originally been proposed, they would cost far less.

"This is your captain speaking. Our recorded music is on the blink. Fortunately, our copilot, Ray Chandler, has been waiting years to do his rendition of the soliloquy from Carousel."

There is an excellent restaurant just below my home; if Mr. Kraft ever comes to Paris, I hope that we can settle this around a bottle of good wine.

Dr. Hansler and His Secret Gun

Your article "Battle of the Big Shots" (August/September 1993) brought back memories. During World War II, I was a technical sergeant attached to a very small Army unit called Ordnance Technical Intelligence Team 3, or OTIT 3. In 1945 we came upon a secluded valley in southern Austria, and in a large chalet we found a Dr. Hansler. Working with a group of assistants, Hansler was trying to develop an electric gun, using magnetic energy for propulsion. They told us they had 6,000 batteries. They also had a prototype consisting of a series of coils approximately two feet long and four inches square. This fired a small steel projectile approximately two inches long and 3/16 inch in diameter with U-shaped copper fins attached at the rear. According to Dr. Hansler and a German machinist, they had built and tested a 20-millimeter outfit that was supposedly disassembled and sent to Berlin when GIs neared the area.



We borrowed the current prototype and took it to our office in Munich, where we tested it using two six-volt truck batteries. I do not know what the velocity was with the small projectile. I do know we had to keep the windows closed in order to keep from hitting someone walking outside. Supposedly, the prototype was sent to Paris for forwarding to Aberdeen Proving Ground in Maryland. I

still have some of the small projectiles today.

—Harrison W. Snyder
Huntingdon, Pennsylvania

The Undead Airman

"The Unknown Airman" (Above & Beyond, October/November 1993) is factually correct in all respects except one. The article listed the navigator, John S. Beatty, and the bombardier, Raymond Edgar, as being dead. Raymond Edgar is not dead; he is the author of this letter.

John Beatty and I evaded capture for two days. After we were caught we were reunited at a jail in Czechoslovakia. Once free I remained on active duty for two years. Then I returned to civilian life but served in the Air Force Reserves, achieving the rank of lieutenant colonel.

—Raymond O. Edgar
Waynesburg, Pennsylvania

Reunion Alert

The China-Burma-India Veterans Association is attempting to locate veterans who served in those countries during World War II. The group is organizing its 47th annual reunion, which will be held September 3 through 8, 1994, in Baltimore, Maryland.

Even if you cannot attend, we would still like to hear from you so we can notify you of future CBIVA programs, including those of the chapters in your area. Please include in your correspondence the name of your unit and where you served.

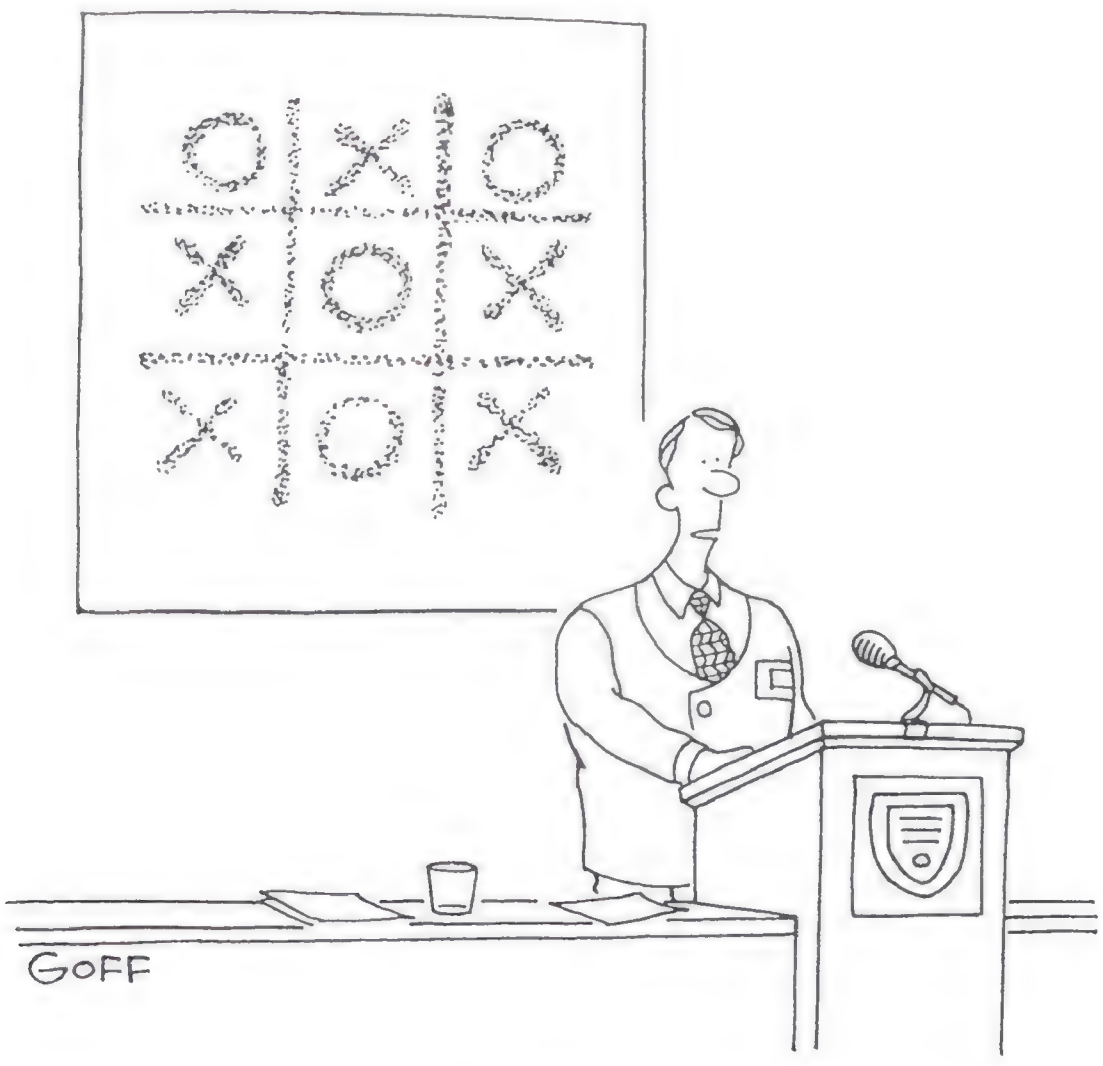
—Homer C. Cooper
145 Pendleton Drive
Athens, Georgia 30606

Thank You, Fellow Buffs

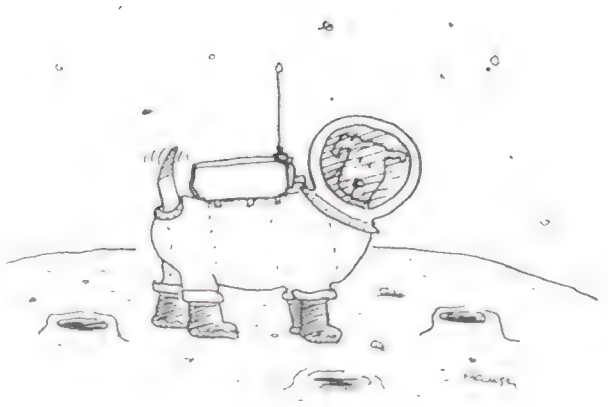
Several months ago, the writer of the following letter asked readers for help rebuilding his aviation book collection after his house was burned down (see Letters, August/September 1993).

Thank you for your immense help in rebuilding my library. It means a great deal to me. Thanks to you and your magazine and of course the American people, today I have got about 50 books and lots of magazines about World War II and modern planes too. Lots of nice greetings from my Croatia. Best wishes and God bless you all.

—Sasa Kolombo
Zadar, Croatia



"Of course, this new comprehensive map of the universe gives rise to certain cosmological questions."



LUNAR ROVER

High Praise

Doug Stewart's "Above the Sky" (August/September 1993) was a wonderful piece. I worked at Eielson Air Force Base in Alaska during the summer of 1965, and my memories of watching U-2s take off are still vivid. I've talked to a few Air Force U-2 pilots over the years and have never heard them say anything negative. Mr. Stewart made me feel like I know the bird and its capabilities a little better. All in all, his story was a joy to read.

—Woody Woodrich
Mill Valley, California

Corrections

June/July 1993 "Training Flight" (Above & Beyond): Though the illustration depicts a B-24 Liberator, the airplane discussed in the article was the Navy version, the PB4Y Privateer, which had a single rear fin and rudder.

October/November 1993 "The Return of Biggles," Soundings: Biggles' creator, Captain William E. Johns, died in 1968, not 1982.

"Over Troubled Waters," Soundings: The satellite photo shows the Missouri River at left, but the white area at right is cloud cover, not the Mississippi.

"At the Threshold of Space": The X-15 made its first free flight in 1959, not 1958; it was X-15 #2, not #1, that was remade into the X-15A-2; and the X-15A-2 made its first flight in 1964, not 1967.

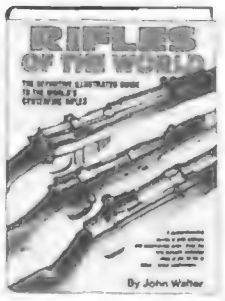
"Dan McIvor's Mars Mission": In the bottom picture on page 56, the man with Barry Simpson is not Roy Copeland but Paul Verreault, who hand-crafts spare parts for the Mars.

Address correspondence to: Letters, Air & Space/Smithsonian, *370 L'Enfant Promenade SW, 10th Floor, Washington, DC 20024. Please type or print clearly, and include your daytime phone number. Letters will be edited for publication.* Air & Space *is not responsible for the return of unsolicited photographs or any other materials.*

TOTAL WARFARE

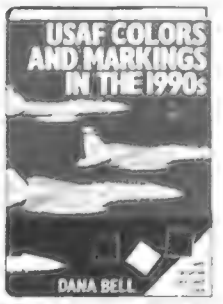
Soar with us high over canopied jungles where Phantoms and MiGs duel in the sky. Dive with us through a blanket of clouds to send a carrier into the Deep. Battle by battle, *The Military Book Club*® lets you witness history as it's made. Get in on *all* the action. Clip the coupon and join us today!

3269-9999* $39.95

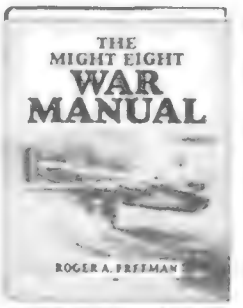


2915+ $19.95

Take 4 for 98¢ with membership



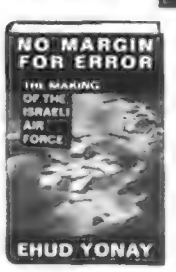
9084-9999* $34.95



2857-9999* $39.95

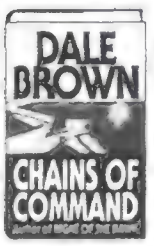
1891 $23.00

3715 $35.00



3749 $27.50

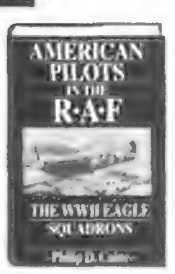
4226 $30.00



3301++ $22.95

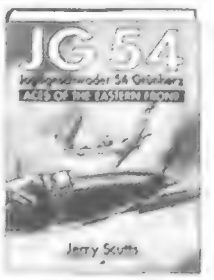
7989 $29.95

4432 $24.95

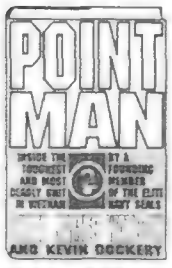


3426 $25.00

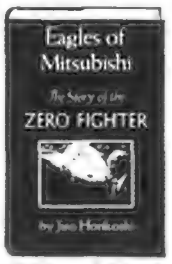
4887 $16.95x



2741 $27.95

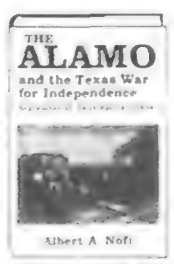


2949 $22.00



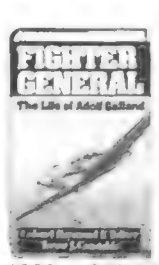
6676+ $14.95

3830 $29.95



4085 $18.95

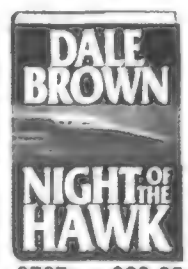
0059 $24.95



6239 $27.50

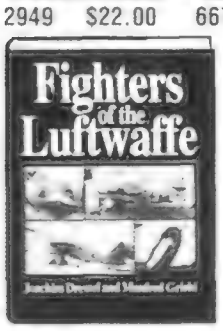
3897 $22.95

3822 $27.50

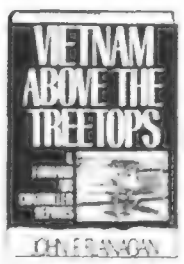


3707++ $22.95

2816 $19.95



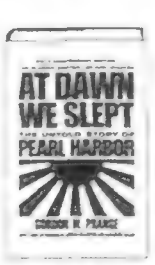
4929-9999* $29.95



0216 $24.95

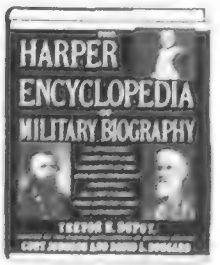
9043+ $15.95

7682 $25.00

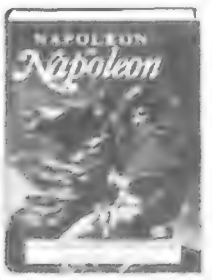


5777 $35.00

4093+ $12.00



7898-9999* $65.00



1586-9999* $29.95

4549-9999* $29.95

* Counts as 2 choices x Special edition exclusively for Club members + Softcover ++ Fiction

HERE'S WHAT YOU GET WHEN YOU JOIN...

A GUARANTEE OF SATISFACTION. Once your membership's accepted, we'll send your 4 BOOKS. If you're dissatisfied with the books, return them within 10 days *at our expense*. Membership will be canceled; you'll owe nothing.

THE FREE CLUB MAGAZINE. You'll receive up to 16 issues a year. Each reviews the Featured Book Selection(s) plus dozens of alternate books.

SHOPPING MADE SIMPLE. To get the Featured Book Selection(s), *do nothing*—it will be sent automatically. If you prefer another book—or none at all—return your Member Reply Form by the specified date. A shipping and handling charge (and sales tax, where applicable) is added to each order.

HUGE DISCOUNTS ON HARDCOVER BOOKS. Save as much as 30% off publishers' edition prices. Club books are sometimes altered in size to fit special presses.

AN EASY-TO-MEET OBLIGATION. Take up to 2 years to buy 4 more books at regular low Club prices. Afterwards, you may resign membership anytime.

RISK-FREE RETURN PRIVILEGES. If you get an unwanted book because your Club magazine was delayed and you had less than 10 days to respond, simply return the book *at our expense*.

Prices shown are for publishers' hardcover editions.
Club hardcover editions save you up to 30%.

THE MILITARY BOOK CLUB® ★★

Your #1 Source for Military Books

MAIL TO: *The Military Book Club*
6550 East 30th Street
P.O. Box 6367
Indianapolis, IN
46206-6367

Please write book numbers here

47998 42

If you select a book that counts as 2 choices, write the first 4 digits of the book number in one row of boxes and 9999 in the next.

YES! Please enroll me in *The Military Book Club* according to the risk-free membership plan described in this ad. Send me the 4 BOOKS I've indicated. Bill me just 98¢, plus shipping and handling.

SAVE MORE—BUY YOUR FIRST BOOK NOW FOR $3.99
Send me the book I've indicated and reduce my commitment to only 3 more books. Bill me an additional $3.99, plus shipping and handling.

(write book number)

47997 41

Mr./Mrs.
Miss/Ms. _____
(please print)

Address _____ Apt. _____

City _____ State _____ Zip _____

Members accepted in U.S.A. and Canada only. Canadian members serviced from Canada, where offer is slightly different. Sales tax added where applicable. We reserve the right to reject any application.

ASP 12/93

Why Did the Airplane Cross the Road?

MICHAEL ABRAMSON

Traffic reporters in Chicago had a field day last September when a Boeing 727 caused a jam on Lake Shore Drive. The airliner, en route to the Museum of Science and Industry as the centerpiece of an interactive exhibit, had been barged to a Lake Michigan beach and towed across the main drag, which was closed to traffic for four hours.

The engineering feat drew thousands of onlookers, including some who were on hand in 1954 when the museum's German U-505 submarine was rolled across Lake Shore Drive on logs. The current crossing, however, became a colossal media event, with some local TV stations broadcasting updates throughout the day.

"We could have disassembled the plane and quietly trucked in its unidentifiable parts by barge," says Deborah Lucien, the museum's communications director, but everyone agreed the high-visibility route was the way to go.

After the airplane reached the museum, the wings were temporarily removed, reducing the airliner's 108-foot width enough to get the craft into the building for display in the "Take Flight" exhibit, due to open next October. A video of the airplane's final landing on Meigs Field's 4,000-foot runway last year and its journey to the museum will be part of the exhibit and will also be displayed in the United terminal at O'Hare Airport.

The blizzard of publicity may have a downside, Lucien adds. "Because of all the excitement—the landing at Meigs and the crossing of Lake Shore—we do wonder if the opening of the exhibit may be a bit anticlimactic."

—Robert Heuer

UPDATE

Biospherians Bow Out

The eight men and women of the Biosphere 2 experiment in Arizona emerged from their three-acre terrarium last September after a two-year stay ("Trouble in Paradise," December 1991/January 1992). All suffered from low oxygen levels, weight loss, bad tempers, and a surfeit of cockroaches and ants. Biosphere leaders said a new crew will take up residence next February for a one-year stay.

Sixty and Counting?

Some people enjoy birthdays, some don't, but there's one birthday that many airline pilots positively dread: their 60th. Under a Federal Aviation Administration rule, that's when they must retire. No exceptions.

Since the rule was adopted in 1959, it has been challenged on legal and medical grounds. Recently, a statistical study of accident data commissioned by the FAA itself found "that one could cautiously increase the retirement age to 63."

That's good news for some pilots but certainly not all. Those eager to fly past 60 say the rule is blatant age discrimination and should be amended or abolished. Those looking forward to retirement at 60 worry that a rule change would disturb those plans. And younger pilots generally support the rule, counting on it to open up vacancies at the top for them to fill.

Both sides claim they're defending safety. One argument goes that in flying, like many other human endeavors, performance declines with age and the chance of sudden incapacitation rises. The opposing view holds that age provides valuable experience, and physical exams and proficiency checks are sufficient to identify and ground potential problem cases.

Last September the antagonists squared off at an FAA-sponsored public hearing in a Washington, D.C. hotel. A large convention room was filled with dark suits with four gleaming stripes on each arm. Chief advocates for the rule were the two largest pilot unions, the Air Line Pilots Association and the Allied Pilots Association, whose members, surveys show, mostly favor the current rule. But the Professional Pilots Federation, a group opposed to the rule, filled most of the seats at the hearing.

As a result, rule defenders often looked like Daniel facing the lions. While criticizing the recent study's methodology, one researcher, intending to say "younger, less senior pilots," inadvertently said "younger, less serious

pilots." A gleeful roar erupted from the older pilots.

David Cronin was among those speaking against the rule. In 1989 Cronin commanded a United 747 that had a hole blown in its side from a failed cargo door. With two engines out and the airplane loaded with fuel for a flight to New Zealand, Cronin made an emergency landing at Honolulu. After one more flight, he was forced to retire. "It seemed ironic that just one week previously the world hailed me as a hero," Cronin said, "but now I was deemed incapable to continue my profession because I had reached that magical number in my age."

Cronin later conceded that his views aren't shared by Al Haynes, the other pilot hero of that year. Haynes was also nearing mandatory retirement when he wrestled a United DC-10 to the ground at Sioux City, Iowa, after it had lost one engine and all hydraulics. According to Cronin, "Al thinks that age 60 is time to retire."

At the hearing, FAA Administrator David Hinson stressed that the agency is keeping an open mind while it considers the rule, the statistical study, and the public comments. If the FAA does move to raise the age limit, a revised rule could be adopted late next year.

—Lester A. Reingold

JOE GALKOWSKI

Lawrence Livermore National Laboratory is lighting up the California sky with its Laser Guidestar, the beam of which helps astronomers learn to compensate for atmospheric turbulence. Airline passengers on red-eye flights may glimpse the laser over Livermore Valley between midnight and 4 a.m.

UPDATE

Wins and Losses

Patty Wagstaff, flying her new Extra 300S, captured the 1993 International Aerobatic Championship last August, winning the U.S. National Aerobatic Championship for the third time (In the Museum, August/September 1993).

Bob Hoover ("Now Playing at an Airport Near You," April/May 1993), who surrendered his medical certificate to the Federal Aviation Administration last April, has dropped efforts to recover it. The airshow pilot gave up his certificate after FAA observers accused him of erratic flying at the June 1992 Airshow America in Oklahoma City.

Terns, Terns, Terns

Near the intersection of runway 31 and taxiway H at the Alameda Naval Air Station in California is a four-acre patch of cracked and broken asphalt surrounded by a three-foot-high solar-powered electric fence. Littered with oyster shells, clay sewer pipes, and cinder blocks, it has the look of an abandoned inner-city lot. The outline of an aircraft carrier looms on the horizon, and nearby, a Grumman A-6 climbs out over San Francisco Bay.

Despite the surroundings, every summer a growing colony of endangered California least terns shows up here to build nests and raise their young. And to Laura Collins, an avian biologist charged with the survival of this particular colony, it's heaven on Earth.

At one time, least terns populated California beaches by the thousands. Sherry Withrow, who works in the environmental department of the air station, recalls fishing at Ballena Bay 25 years ago, when, she says, there were so many least terns it was difficult not to step on them. But the bay shore, like so many other nesting areas, was eventually paved over and covered with condominiums. Desperate for another flat, barren area near a lagoon or estuary, the birds chose the tarmac at the air station.

Collins was called in to enhance the site. Operating with a tiny stipend from the state and the Audubon Society, she rid the area of cats, persuaded the Navy to erect the electrified fence, and scattered sewer drain pipes so the birds could hide from predators.

JORDAN COONRAD

Even so, things looked grim. In 1982 none of the fledglings made it to the end of the nesting season. The following year only three pairs of terns showed up. "It was a real wipeout," Collins says.

Then, inexplicably, the numbers started increasing dramatically. By 1987 so many fledglings were on one of the runways that the Navy closed it down for 10 days to protect them. Last year 228 fledglings survived, making the air station one of the more promising breeding grounds in the state. "The Navy has been incredibly supportive," Collins says. Not only does it earmark $50,000 a year for the site, but the tower routes helicopters and C-5s away from it so they don't pass over the nesting area.

The Alameda Naval Air Station is just one of the military facilities in the state that provide the least terns' best odds for success. The most dependable colony nests at Camp Pendleton in southern California, and others have chosen North Island Naval Air Station in San Diego, Point Mugu, Seal Beach Naval Weapons Station, and Vandenberg Air Force Base. Ironically, projected base closures now threaten the survival of the species, particularly the colony at Alameda: the air station is on the Pentagon's hit list. This has made bird watchers and base supporters strange bedfellows indeed. Any future use of the site that receives federal funding will, under the conditions of the Endangered Species Act, have to take the least terns into consideration. But it's unlikely that any civilian use of this prime San Francisco Bay real estate will.

—Elaine de Man

SETI Scrapped Again

Last October, one year after NASA initiated the High Resolution Microwave Survey, which scans millions of radio frequencies for signals that might indicate extraterrestrial intelligence ("SETI Takes the Hill," October/November 1992), House-Senate conferees eliminated the $12 million project from the NASA budget, leaving $1 million to shut it down. An astronomer at the SETI Institute in California said other sources of funding are being investigated, including private foundations.

Skeletons in the Closet

France celebrated the 50th anniversary of the death of Pierre-Georges Latécoère last September, feting the famed seaplanes produced by the designer's firm.

The 80-year-old company is a survivor. It has not disappeared in mergers, but has kept the name of its pioneer founder, who ran the first postal airline to Africa (1918 to 1927), later absorbed by Air France at that airline's launch in 1933. Latécoère's pilots—Antoine St.-Exupéry and Jean Mermoz among them—scored the first France-South America crossing entirely by air, the first France-Morocco postal delivery, and the first flyover of the Andes, all in single-engine craft.

It turns out that Latécoère was also in the bomb business, a secret revealed at the anniversary conference. Until 1958, Latécoère had two classified missile programs, which were studied by the U.S. Army's Rocket Branch in 1944.

The missiles, called Malafond and Malaface, could be launched from airplanes or ships. But they never were. After untold millions and years of research, someone in government said "enough," and the ax came down on the plan.

But not all the way. An even better-kept secret was a last-ditch effort to salvage something of the project. Another bureaucrat decided to turn the Latécoère missile into a postal rocket. That would have pleased the old man, who founded France's aeropostale airmail services.

France's National Center for Technical Studies converted a Malaface into a flying postman capable of carrying 1,100 pounds of postcards 31 miles. The rocket was built, mobile ground stations were erected, and the winged letter carrier was all set to be launched from the Algerian desert when yet another bureaucrat stopped the program for good.

Today Latécoère makes flaps for the Falcon 900, doors for the Airbus 320, the fuselage for the Rafale, and noses for the Airbus 600. No postal service is currently on the drawing board.

—Joshua Jampol

Dulles, Stretched

At a ceremony celebrating the beginning of the expansion of Dulles airport near Washington, D.C., last October, the program listed the usual lineup—color guard, some speakers—and this eye-catcher as a final item: "Groundblasting." Metropolitan Washington Airports Authority general manager James Wilding noted in his concluding remarks that the

BRIAN NICKLAS

Separated at birth? Asteroids Ida (top), in 1993, and Gaspra, 1991, both photographed by the Galileo paparazzo spacecraft.

terrain in northern Virginia is notoriously hard, so the ceremonial ground-breaking would be accomplished with dynamite.

With that, a horn sounded three times—the traditional warning signal before blasting—and, led by Wilding, the assembled airport employees and dignitaries began a 10-second countdown. After they reached zero, there was an awkward pause. Then came a series of sharp cracks and flying sparks at the center of the future construction site, followed by a muffled WHOOOM. A heavy blasting mat heaved into the air and settled back, like a down blanket thrown off a bed. Dulles had a new hole in it, and soon it will have a main terminal 320 feet longer on each end. (A construction executive explained that the pyrotechnics prior to the blast were the work of a creative blasting crew, who rigged a series of detonators and explosive primer cord to produce a small-scale Fourth of July.)

The terminal building, designed by architect Eero Saarinen in the 1950s, has always attracted adjectives like "sweeping" and "open." When the expansion is completed, the terminal will finally sweep to the full width Saarinen had envisioned and enable the now-congested airport to handle more than the current load of 11 million passengers yearly. At its dedication ceremony in 1962, the airport's main terminal opened for business with its ends lopped off due to low traffic predictions. And during the early years, critics charged that the airport was a "white elephant." Visitors at the time noted a strange silence about the place.

In the 1980s, with airlines rushing to open new hubs following deregulation, Dulles' long runways and proximity to Washington attracted airlines like United to the long-underused airport. Traffic began to increase as well, and today the Sunday afternoon rush creates New York-style gridlock on the service roads. With Saarinen's original master plan still in hand, the airport authority had only to pull out the original blueprints to start work. The terminal expansion is scheduled for completion in 1996; the road improvements will be done by 1997.

—George C. Larson

The Dark Matter Matter

Four groups of astronomers have independently recorded evidence of massive compact halo objects, or MACHOs, in 1993 ("The Case of the Missing Matter," February/March 1993). All cases involved a gravitational lensing event, two occurring with stars brightening and fading in the Large Magellanic Cloud and two discovered in the Milky Way.

Posted in a NASA building in Houston last September after Jet Propulsion Laboratory controllers lost contact with the Mars Observer.

The Genuine Leather U.S. Army Field Jacket

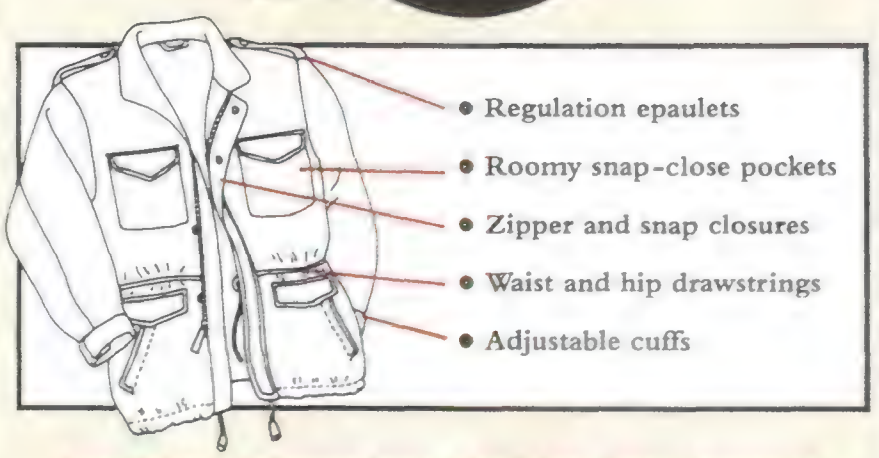
Millions of fighting men swear by it. Now, you can own it in genuine leather!

Ask any man who ever owned one…he'll tell you it's the best jacket he ever had. For millions of G.I.'s, the official issue U.S. Army Field Jacket was *the* most prized piece of gear from Army days. Earning its stripes from World War II to Desert Storm, it always came home with the troops. Now, *The Genuine Leather U.S. Army Field Jacket* combines the rugged good looks and comfort of the jacket that veterans treasure with the richness of supple genuine leather! Available exclusively from Willabee & Ward.

Authentic Details. Practical Hip-Length Cut.

All the great features that made the original so popular are here. For starters, there's the famous fit and cut. It's comfortable and it covers you to the hip. The regulation shoulder epaulets, roomy snap-close pockets, zipper and snap-front closures, adjustable cuffs, and drawstrings at the waist and hip. What's more, we've updated the classic design by adding convenient side-entry pockets, two zippered inside breast pockets, and a comfortable satin-blend lining. The result is a great-looking jacket that's perfect with jeans, yet the luxurious genuine leather makes it dressy enough for a night on the town.

Also available in Black Leather.



Just $199. Convenient Monthly Installments.

The Genuine Leather U.S. Army Field Jacket is available in brown and black and is priced at just $199 (plus $9.50 shipping/handling), payable in six monthly credit card installments of only $34.75. Comes with a 30-day money-back guarantee. Available in sizes S, M, L and XL. Call about larger sizes (XXL and XXXL) for $50 more. Have questions about sizing? Call us — we'll fit you over the phone. Phone orders normally shipped next business day.

CALL TOLL-FREE: 1-800-367-4534
EXT. 685-155

Willabee & Ward
47 Richards Avenue
Norwalk, CT 06857

Satisfaction Guaranteed

CALL TOLL-FREE: 1-800-367-4534 Ext. 685-155

Please send me ___ *Genuine Leather U.S. Army Field Jacket(s).*

Sizes(s) (Circle): Small (38-40) Medium (42-44) Large (46-48) Extra Large (50-52)

Color(s) (Circle): Brown Black

For each jacket, charge 6 installments of $34.75 * to my credit card ☐ VISA ☐ MasterCard ☐ Discover ☐ Am. Ex.

Credit Card # Exp. Date

Name _____
(PLEASE PRINT CLEARLY)

Address _____

City/State/Zip _____

Signature _____
(All orders subject to acceptance.)

☐ I prefer not to use a credit card and will pay by check. Enclosed is my check for $199 plus $9.50 shipping/handling, a total of $208.50 * for each jacket.

*Any applicable sales tax will be billed with shipment.
Higher shipping/handling outside U.S.

THE WONDERS OF WAR

When the Arado Ar 234B Blitz bomber took up residence in Gallery 104 in September, the National Air and Space Museum already had three other "wonder weapons" from Nazi Germany on display. Visitors can find the Me 262 fighter in the Jet Aviation Gallery and the V-1 "buzz bomb" and V-2 rocket in Space Hall. Some visitors may be so impressed by these artifacts that they will wonder if Nazi Germany could have used them to win the war.

"That's why I wanted to do this exhibit," says Michael Neufeld, a curator who worked on the Arado display. "There are too many myths out there about German 'wonder weapons.' Not one of these things had a hope in hell of winning the war." Yet despite the persistent legends—in particular, that Hitler blew his last chance of regaining air superiority over Germany when he insisted that the Me 262 be used as a bomber instead of a fighter—Germany was overwhelmed by the Allied powers, wonder weapons or no.

That's not to say that these weapons weren't technologically advanced; the Ar 234B was the only jet-powered bomber to see service during the war. "It was most effective in its original role on high-altitude reconnaissance missions," says Neufeld. "For its time it was quite an achievement, for its speed, its ability to evade Allied defenses."

It was also an incredibly sleek aircraft, one that was pared down by necessity to the fundamentals of flight. A slender, high-wing craft with a plexiglass nose, the Arado was crewed by a single pilot, who doubled as either bombardier or photographer, depending on the mission. The airplane was powered by twin Jumo 004 turbojet engines, the same powerplants used by the Me 262. It had a top speed of about 460 mph and was faster than anything the Allies could field, giving it impunity while at altitude during reconnaissance flights. But technical difficulties with the engines kept the Arado out of the war until September 1944, and only about 200 were ever manufactured.

CAROLINE SHEEN

As a bomber it was used during the Battle of the Bulge, and in March 1945 Arados from the KG 76 bomber wing were used to attack the Remagen bridge, over which Allied troops had made their first crossing of the Rhine. Five of them were shot down. "It was not very effective as a bomber, in part because there were so few of them, they had a limited bomb load, and they were underpowered," says Neufeld. In fact, heavily laden Arados needed rocket-assisted-takeoff units, which used hydrogen peroxide to provide extra thrust.

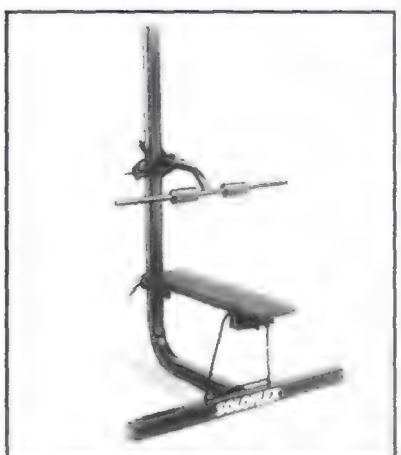
The engines that gave the Arado its great advantage in the air were also one of the aircraft's greatest weaknesses. Struggles with the new technology kept delaying deployment of the aircraft (this obstacle was also the real reason that the Me 262 never swept the sky clean of Allied bombers). Even when they worked, the engines required a lot of maintenance: their operational lifetimes were only about 20 to 25 hours. "That was exacerbated by the lack of critical materials, like high-temperature alloys," says curator Tom Dietz. "The combustion chamber was lined with aluminum, which burned away gradually and eventually failed."

The Museum's Arado is the only one of its type surviving today. "It's depressing to think, but the Allies had 10 but every other one was scrapped," says Neufeld. "They had one at Pax River [Patuxent River Naval Air Station in Maryland] until as late as the 1960s and they bulldozed it into the ground." The Museum's Arado served with the KG 76 bomber wing, flying training missions with the Eighth Squadron. At some point near war's end it was flown to Norway, probably to avoid capture. It was recovered there by the British and later handed over to the Americans, who shipped it to Wright Patterson Air Force Base in Dayton, Ohio, where it was stored until the Air Force donated it to the Smithsonian in 1949. It was restored at the Museum's Paul E. Garber facility in Suitland, Maryland, and painted in the colors of the KG 76's Eighth Squadron, a choice that required a little guesswork.

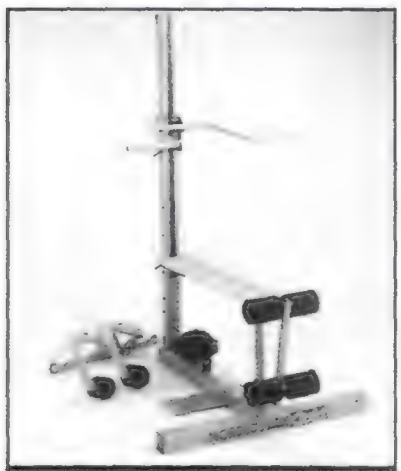
SOLOFLEX®? NORDICFLEX GOLD™? THE BETTER CHOICE IS HEALTHMAX™! AND IT COSTS $600–$700 LESS!

These pictures and charts tell the story. **HEALTHMAX** gives as much and more despite the astounding difference in price.

HEALTHMAX



SOLOFLEX



NORDICFLEX GOLD

9 Powerful Reasons to Choose HEALTHMAX as Your Total-Body Fitness System.

THE REASONS	HEALTHMAX	SOLOFLEX	NORDICFLEX GOLD
1 Low price	YES **$329** (plus $49 S/H)	NO **$995** (plus $105 S/H)	NO **$999** (plus $99 S/H)
2 Easy to use	YES No assembly/disassembly required between exercises.	NO Requires assembly/disassembly between exercises.	NO Requires assembly/disassembly between exercises.
3 Leg Extension Unit included	YES Permits both leg extensions and lying leg curls.	NO Costs $200 extra.	YES **BUT...**Leg unit included doesn't permit lying leg curls.
4 Butterfly Unit included	YES No extra cost.	NO Costs $200 extra.	YES **BUT...**You must assemble before each use, and disassemble to use bench press.
5 Strength conditioning for all five major muscle groups	YES **HEALTHMAX** strengthens all five: arms, legs, abdominals, back and pectorals.	YES **BUT...**You must purchase $400 in extra accessories to do comparable exercises for legs and pecs.	YES **BUT...**Why would you pay $700 more than **HEALTHMAX**?
6 Comfortable bench	YES Padded bench is a full 47" long, 12" wide, and a comfortable 20" high.	NO Padded bench is only 40" long, making some lying down exercises awkward	NO Padded 40" bench is short, narrow (only 9" wide), and too high (24") off the ground.
7 Hydraulic cylinder resistance system	YES Adjusts to your personal resistance level with a simple twist of a dial.	NO Uses rubber bands which must be changed to vary resistance level.	NO Uses complicated cord/pully/mechanical resistance system
8 Full refund of return freight if unit returned	YES If not satisfied, we will refund your cost, shipping/handling charges, and all return freight!	NO You pay over $85 to return. It must go by truck to Oregon!	NO You pay about $65 to return by UPS.
9 Payable in installments	YES 9 easy installments of just $36.56! ($49.00 S/H added to first installment.)	YES **BUT...**You pay $39 per month for the next 2 *YEARS!*	YES **BUT...**At 4 payments of $250, each installment is almost as much as the total cost of a **HEALTHMAX**!

How do we do it? How can we give you as much and more for so much less money?

No Expensive Stores!

You won't find us in the high-priced retail space at your favorite mall. We sell direct to save *you* money!

No Expensive TV Ads!

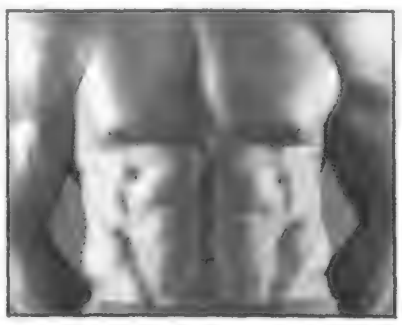
Don't look for us on television. Too expensive! We pass the savings on to *you.*

Less Profit, More Value!

NordicFlex Gold is made by a public company; we've seen the profit figures. We make a lot less on each machine — so we can give *you* a lot more *value!*

When you compare, the choice is easy... it's HEALTHMAX!

Let's face it, when all is said and done, what you really want is a body like this. Until now, that meant spending $1,000 or more for a Soloflex or NordicFlex Gold. But now the secret is out... **HEALTHMAX** gives you as much —and more—for up to $700 less! So call today to get the hard body you want for just $329. And while you're at it, take the $600–$700 you'll save and buy yourself a reward.



CALL TOLL-FREE FOR A 30-DAY NO-RISK HOME TRIAL: 1-800-458-4652 • Ext. 638-1273

HEALTHMAX™
47 Richards Avenue • Norwalk, CT 06857

PAT RAWLINGS

When the airplane arrived at the Smithsonian, says Dietz, "it had no original markings left. The Air Force had stripped it. We do have a color photograph of the airplane taken in 1945 in the States. Unfortunately, some of the German markings—the squadron codes—had been painted out. The 'G' with the red border is a guess."

Now the beautifully restored Arado sits in Gallery 104, replacing the P-47 Thunderbolt in the "Air Power in World War II" series. Nearly a half-century after its debut, the Arado's graceful lines still elicit a sense of wonder that Nazi Germany managed to build this beautiful, advanced craft even as it was losing the war. Although the Arado's effect on that conflict was negligible, Dietz points out that the German wonder weapons had a great impact after the war. "The F-86 and the MiG-15 were both designs that were strongly influenced by German wartime aerodynamic research," he says. And the American space program leaned heavily on the V-2 rocket and the knowledge gained from captured German scientists. But as far as winning the war, says Neufeld, "The real wonder weapon was the A-bomb."

The Arado will be on display until fall of 1994, when construction of an exhibit to house the *Enola Gay* fuselage will require its removal. The wonder weapon of historical legend will be replaced by the airplane that carried into war the true wonder weapon: one with repercussions that still haunt us a half-century later.

—Tom Huntington

Artist as Advocate

Space artist Pat Rawlings visited the Museum last fall to talk about how he paints events that have never happened as if they had or most certainly will. A tall, serious Texan, Rawlings showed a small audience a selection of his paintings in a slide show that, had the pictures been real, would have represented zillions of dollars' worth of space exploration. Rawlings' work, most of it commissioned by NASA and aerospace engineering companies (and occasionally by this magazine), has a definite "can do" look. He paints moon colonies, planetary mining operations, astronauts scaling Martian cliffs, robotic rovers touring lunar and Martian surfaces, and various space-faring vehicles with astronauts busily engaged in discovery. If the people in the audience weren't impatient with the pace of the world's advances in space when the show started, they almost certainly were by the time it was over.

"The reason I specialize in space art is that I have feelings about the subject matter," Rawlings said in response to a question about the advocacy so obvious in his art. "I paint things I'd like to be doing."

His paintings have an unheroic, matter-of-fact quality that nags you to accept, despite their exotic settings, the reality and even advisability of the activities portrayed. Long before you see the title of a painting of Mars exploration that appears in the Museum's "Where Next, Columbus?" gallery, you feel the Rawlings nudge. The realism and almost casual pose of the disembarking traveler say "We can do this, it's not that difficult." The title is "Inevitable Descent."

Rawlings' pictures are a blend of scrupulous research and hard-working imagination. For "Return to Utopia," a painting that predicts a human follow-up to Viking 2's 1976 landing in the Utopia Planitia region of Mars, Rawlings scanned into his computer a calibration grid NASA used for interpreting photographs returned by Viking's cameras. With the photographs and calibration grid,

ARTIFACTS

MARK AVINO

On July 14, 1911, President William H. Taft awarded this gold medal to Harry Nelson Atwood for flying a Burgess-Wright biplane from Boston to Washington, D.C. The journey lasted two weeks and included stops in New York City, Atlantic City, Baltimore, and College Park, Maryland. Atwood, who had learned to fly at the Wrights' school in Dayton, Ohio, worked as a flight instructor and demo pilot for the Burgess Company. The young aviator ended his trip by landing his biplane on the White House lawn to receive the medal from Taft. In 1992, Atwood's widow, Nellie Atwood Pickens, and his daughter, Nelda Atwood Stiles, donated the medal to the Museum.

Rawlings generated a computer model showing the precise locations of the hundred or so rocks that were in Viking's field of view, and there they are in the painting, just as they are on the planet's surface.

Among the more lyrical of Rawlings' works are his paintings of astronauts working on the moon bathed in "Earth shine"—sunlight reflected from Earth, which is some 70 times brighter than the light from a full moon. Earth shine casts a lovely glow in the paintings and gives the scenery an optimism almost as strong as that behind one work's title, "August 21, 2017."

—Linda Shiner

Museum Calendar

Except where noted, no tickets or reservations are required. To find out more, call Smithsonian Information at (202) 357-2700 Mon.–Sat., 9 a.m.–4 p.m.; TTY: (202) 357-1729.

December 2 "Exploring the Giant Outer Planets." Journey to the four giant planets in the outer solar system with Edward C. Stone, director of the Jet Propulsion Laboratory, as he recalls the missions of Pioneer and Voyager. Langley Theater, 7:30 p.m.

December 4 Monthly Sky Lecture: "Giants in the Sky." David DeVorkin of the Museum's department of space history will discuss stars and how they vary in size, color, and configuration. Einstein Planetarium, 9:30 a.m.

December 9 G.E. Aviation Lecture. Wilkinson Wright shares fond remembrances of his famous great-uncle Orville near the 90th anniversary of the Wright brothers' flight at Kitty Hawk. Langley Theater, 8:00 p.m.

January 8 & 9 Family Film Festival: *Duck Tales: The Movie.* Gallery 211, 1:00 p.m.

January 15 & 16 Family Film Festival: *Flight of the Navigator.* Gallery 211, 1:00 p.m.

January 20 G.E. Aviation Lecture. Richard Abrams, director of flight testing at Lockheed's "Skunk Works," will discuss the 50th anniversary of the XP-80, the first aircraft produced at the facility. Langley Theater, 7:30 p.m.

January 22 & 23 Family Film Festival: *Jetsons: The Movie.* Gallery 211, 1:00 p.m.

January 29 & 30 Family Film Festival: *Aladdin.* Gallery 211, 1:00 p.m.

Power Play

On long flights, piloting a corporate jet with a cockpit full of electronics, I sometimes wonder if I could be replaced by a computer. You could program the airplane with the route and performance parameters, and then, with the push of a button, send the boss on his way. No hotel rooms, no expense reports. And a computer can be programmed to spot trouble in the airplane and switch to alternate systems much faster than a human. With a little work on the software, a computer could not only diagnose a problem but fix it. Then we could work on replacing brain surgeons and first basemen with computers.

I don't know any brain surgeons but I was talking to my friend the first baseman the other day about replacing him with a computer. He was not impressed with the idea. For one thing, he said, computers aren't fun to watch. They don't make mistakes and they don't spit or scratch or miss anything in the strike zone. I said team owners would want computers because they work cheaply. He countered that it would end up costing more. Not only would it require a lot of people on the payroll to keep the computers running but the owners would also have to keep a backup human in case the computer blew a whatchamacallit in the top of the fourth.

I don't think I'll be replaced by a computer either. Maybe it's macho bravado, but when a fancy fly-by-wire airplane makes unscheduled contact with the ground and the cause is listed as computer error, like the 1989 crash of a Saab Gripen in Sweden, a lot of pilots wonder out loud if the pilot could have saved the airplane had he or she been given more authority to override the computer.

Last year, on a trip to Europe, I was reminded that piloting skills are still useful, no matter how many electronic helpers there are in the cockpit. A fierce storm had battered us from the time we landed in Spain, and it was raining so hard that the sky had turned green. On the second day we spent waiting to depart, the weather would not cooperate: crosswinds gusting to 40 knots, indefinite ceiling, sky obscured, visibility less than 1,500 feet in rain and fog.

On the third day the weather began to moderate, which meant that it wasn't raining quite as hard. The wind had slackened to 20-knot gusts and was more aligned with the runway. The weather along our route had taken a turn for the better as well. I decided to go.

In position on the runway, we ran our last checklist. Because of the weather, we elected to leave the auxiliary power unit up and running and auxiliary power armed. The APU is a small turbine engine in the tail compartment that provides a backup electrical power source in the unlikely event that primary power is lost. The electrical system on our airplane was classic overkill, supplying roughly five times the power needed for an average home even though less than half of what it made was used. The distribution system was automated, forever on guard for any anomaly in its vast network of wires and sensors, seeking to energize each electrical bus with the best source of juice. Electrical power problems in airplanes are largely a thing of the past, the kinks having been worked out long ago, but in rare events when a short circuit or failed element in the electrical system causes a problem, circuit breakers and current limiters are supposed to interrupt power to the affected circuit and connect the bus to the next best source before something really bad happens. All this takes place in milliseconds and is usually over sometime between the pilots' first instinctive flinch and their first remark, which is traditionally brief and to the point.

ROSEMARY HENSHAW

The day we left Spain, we had a perfectly good airplane—not a single burned-out bulb. I pushed the thrust levers forward and the twin Rolls Royce fan engines spooled up, gobbling vast quantities of wet air and expelling it with the force of a hurricane, sending us on our way.

I think we were about 300 feet off the runway when the lightning hit. A brilliant flash lit up the cockpit, and immediately all those electronic gizmos that tell us which way is up and where we're headed ducked for cover. The standby attitude indicator, altimeter, and airspeed indicator, the only flight instruments that are of use in an electronic cockpit when the power goes out, were still working; the rest of the instrument panel was useless.

All proceeded exactly as the designers of the airplane had planned. The sensitive electronic displays and system components retired in response to their protection features. The APU alternator was now providing power for the right main buses. Instead of a full-up vulnerable electrical distribution system in which a problem at one point could cripple the whole system, essential components were isolated, powered by dedicated emergency batteries. We were back to

basics: an airplane, albeit a $25 million one, with human pilots flying by reference to simple pitot-static instruments just like the ones I struggled to interpret in single-engine Cessna trainers years ago. The airplane was flying, though, and flying straight and true. Nothing seemed to be bent or broken, as sometimes happens with lightning strikes.

After the warning lights quit flashing we took stock of what we had left in the way of an electrical system. I flew the airplane and the copilot did the button pushing to handle the emergency. One of the computers ventured a peek to see if there were any more gazillion-volt monsters lurking and decided it was safe to come out. With that first significant victory, the level of tension in the cockpit lessened noticeably. One by one, following the checklist, the copilot restarted almost all the electronics—enough to make it to a repair facility.

An instructor later told us exactly what had happened in the nether regions of the airplane's electrical system in those milliseconds. After reading the pilots' and mechanics' reports, he concluded that we had not really been hit by lightning, that we only transited an area where an unusually high level of ambient electrical activity (together with rain that would strangle a frog) had caused my right alternator to fail. He knew which downstream part of the system sensed an out-of-limits condition and tripped before all the wires and chips and secret stuff melted together into an expensive electronic mush from which nothing could be salvaged.

I don't know why I've never made friends with electricity. My airplane is so dependent on the mystical movement of electrons throughout its miles of wiring that without them the aircraft simply refuses to start at all. I, however, can take it or leave it. The feeling I sometimes get in the cockpit, especially at night, is the same detached feeling I get in a Gulfstream IV simulator. I see a collection of 11 cathode ray tubes, 18 dials, 267 lighted buttons, 381 circuit breakers within reach, 142 switch capsules with four lights each, 184 selector switches with two lights each, 21 standby warning panel annunciators, and a host more. Making sense of all this is a collection of computers that controls everything from the information that flows between the pilots and the airplane to the information that flows within the airplane itself, between sensors and computers and between computers and computers. The whole thing can get a bit surreal until the computers decide to take a break. Then it's back to flying airplanes like God and Orville and Wilbur intended. And there's no computer anywhere that can do that.

—Alex Nelson

Ski Edwards!

In the winter of 1964-65, we got a series of particularly heavy rains that flooded the dry lake beds at Edwards Air Force Base in California, where I was working as a NASA research engineer and pilot. Throughout the year we tore up the lake beds with rocket research aircraft and by making emergency landings with the X-15, the lifting bodies, and other unusual aircraft. The storms were an annual occurrence and a welcome one—the water blowing back and forth on the usually dry lake beds resurfaced them.

This particular winter one lake bed had accumulated about six inches of water. First-time visitors were impressed to see a huge lake in the middle of a barren desert. We would string them along, talking about fishing, sailing, and water skiing.

One day I opined that we actually could ski on the lake if we could find a suitable tow vehicle. Several pilots disagreed. We ended up in a vigorous debate. Someone suggested we settle the argument by giving it a try.

I wasn't too thrilled, since I knew it would be risky. A half-foot of water does not provide much cushion if you take a bad tumble. But I was not going to back down. I thought that one of the experienced water skiers would volunteer, but I was dead wrong. I was unanimously selected. I argued that I had never water-skied before, but that didn't work.

Once the sacrificial lamb had been selected, we decided that the logical tow vehicle would be our little Bell helicopter. It had the required power and enough room for a tow line tender.

The next morning an eager beaver brought in a pair of water skis and also volunteered to fly the helicopter. The gauntlet had been thrown down and I had to pick it up. I went down to the pilots' locker room with the skis on my shoulder. Joe Vensel, director of flight operations, passed me in the hall. He looked askance at me and the skis, but he didn't say anything. Neither did I.

In the locker room I changed into my oldest flightsuit and most beat-up flight boots. If I should happen to fall I would bottom out in the mud, which was sticky and slippery as grease. You could probably water ski on the mud itself.

I picked up the skis and walked out to the flightline. The helicopter had been towed out of the hangar and the crew was finishing the preflight inspection. Vic Horton, project engineer on the M2-F1 lightweight lifting body, had offered to fly as the tow rope tender and monitor.

By this time, a large crowd had gathered on the ramp and on the roof of the main office building. Word got around the center very fast in those days. It was common for all the employees to watch our research aircraft fly, particularly first flights and any emergency landings on the lake bed. Today the spectators were going to witness another strange NASA operation: a helicopter dragging a human body through the mud.

We laid out the tow rope from the helicopter to the ramp at the edge of the lake bed, and the helicopter crew started the engine. I walked to the ramp at the edge of the lake and began putting on the skis. I was having second thoughts about the whole idea, but it was too late to back down. I picked up the end of the rope and waited for the helicopter to get airborne.

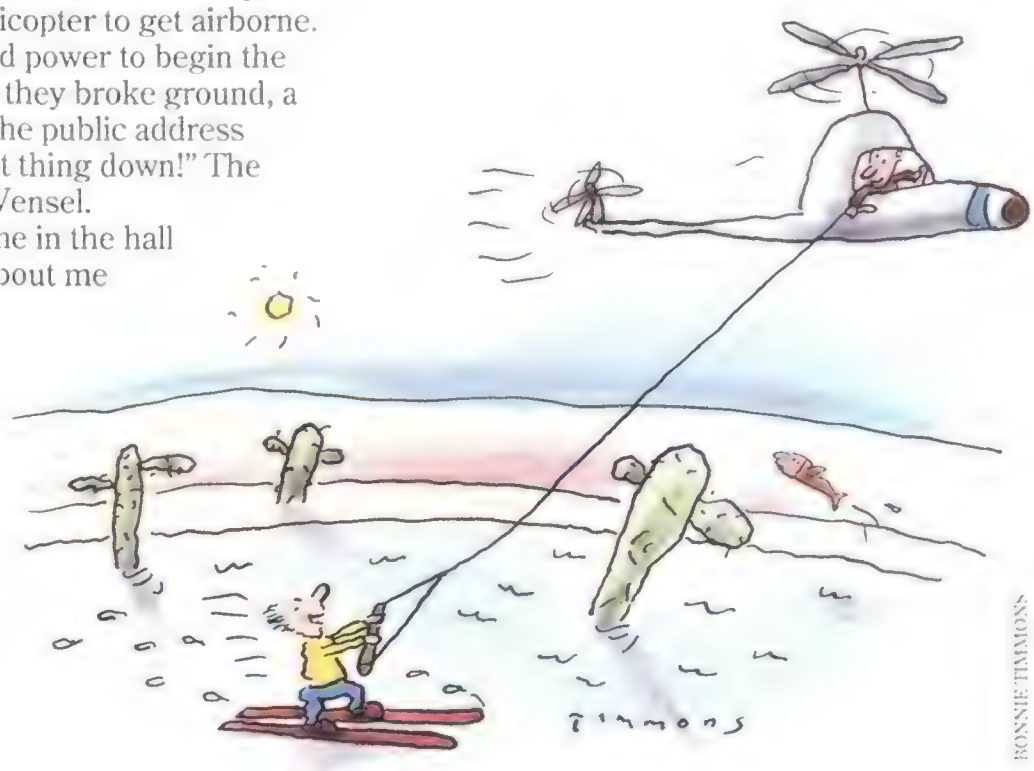
The crew added power to begin the liftoff. Just before they broke ground, a voice came over the public address system: "Shut that thing down!" The speaker was Joe Vensel.

After passing me in the hall he had thought about me and the skis, remembered the arguments he had overheard in the pilots' office the previous day, and decided he'd better see what was going on. When he got back to his office, which overlooked the ramp and lake bed, he could hardly get in—it was filled with spectators, including Paul Bikle, the center's director. He immediately got on the PA and commanded the shutdown. Bikle didn't say a thing—I think he would have let us try it.

Vensel thoroughly chewed out all participants. I was somewhat flabbergasted to learn that his main concern was that I might break an arm or leg and not be available to fly the X-15. There were only four of us flying those aircraft, and a temporary loss of one pilot would have been a major setback. Still, it seemed cold-blooded to be more concerned about the airplane being flown than about my personal well-being. I was about to ask Vensel if he would be sorry if I broke my neck water-skiing, but thought the better of it.

The helicopter crew later admitted that they had planned to tow me out to the middle of the lake and then drop the tow line. It would have been almost impossible to walk the two miles to shore in that mud. I'm glad I got that last-minute reprieve.

—Milton O. Thompson



AIR & SPACE SMITHSONIAN MAGAZINE

Presents

Dreams of FLIGHT

A Deluxe 3 Volume Boxed Set. . . A must for every aviation and space enthusiast. . . or anyone who has ever dreamed of exploring worlds beyond their own. . . Over 100 airplanes featured.

Call 1-800-466-7766 and order yours today !

A COLLECTION OF DREAMS

For the first time, AIR & SPACE/SMITHSONIAN MAGAZINE captures on video all the thrills and adventures of those events and aircraft that lifted mankind from the confines of this earth into the outer reaches of our solar system. Inspirational as well as educational, the *DREAMS OF FLIGHT* three tape video series brings to life the irrepressible spirit of those heroic men and women whose achievements have become a legacy for generations yet to come.

SATISFACTION GUARANTEED

If for any reason you are not satisfied with these videos, just return them to us and your money will be cheerfully and promptly refunded.

High quality family entertainment . . . a must for every video library !

SunWest Marketing Group, Inc.
1801 Oakland Blvd., Suite 315-B
Walnut Creek, CA 94596-7000

Call 1-800-466-7766

Please place my order for_____sets of *"DREAMS OF FLIGHT"* at $69.95 plus $7.45 for shipping and handling of each set.
No COD orders. Indiv. titles sold separately @ $24.95 plus $4.95 shipping and handling
Send me___copies of _____

_____ ☐ Visa ☐ MasterCard

_____
Credit Card # Exp. Date

Name _____

Address _____

City/State/Zip _____

Signature _____

Telephone No _____

AS1293

LIFE AFTER EASTERN

When Eastern Air Lines crashed, it took its employees along with it. Some of them are still trying to crawl out from the wreckage.

by Henry Scammell

Photographs by Brian Smith

For Eastern Air Lines, the end came on January 18, 1991. The company had been in the headlines off and on since its 1986 purchase by Frank Lorenzo, then chairman of the Texas Air Corporation. Lorenzo had run into trouble with Eastern's unions when he asked for pay cuts that would give Eastern workers salaries closer to those of Continental's non-unionized employees. The unions struck in March 1989, and management responded by filing for bankruptcy.

One reason Eastern's subsequent death, like that of Pan Am soon after, came as such a shock was that the airline had been around for so long. In the 1930s, Eastern was one of the Big Four—along with United, American, and TWA—providing air service in the United States. For millions of vacationers, Eastern was the airline that flew them from cities in the northeast to Florida during the winter. At its peak, Eastern employed 40,000 people.

Many former Eastern employees blame Lorenzo for the company's downfall, but Eastern had actually been in serious financial trouble since 1982, when it was under the leadership of former astronaut Frank Borman. When Borman became president in 1975, he began an aggressive expansion that piled the airline with debt. In addition, Eastern paid its workers some of the highest salaries in the industry, and after deregulation in 1979, the company couldn't compete with its new, lower-cost rivals. Soon Eastern was losing millions of dollars a year.

Lorenzo declined to be interviewed for this article, but he did release the following statement to *Air & Space/Smithsonian:* "Tragically, the people of Eastern were hurt by the combined effect of deregulation, which demanded that Eastern adjust to economic reality, and by union leadership, which hoodwinked some very fine people into believing that resistance to economic reality and fighting a symbolic villain was in their best interest. It wasn't. But the employees of Eastern, including the vast majority of mechanics, pilots, and flight attendants who opposed what I was trying to accomplish, were good, hard-working people."

Union leaders did portray Lorenzo as a villain; they felt he must be stopped at any cost. The power to bring Lorenzo down, however, came from the rank and file, the thousands of pilots, flight attendants, and machinists who voted to go on strike.

The relationship between Lorenzo and Eastern became so troubled that the company's creditors were able to convince bankruptcy judge Burton R. Lifland that Texas Air management was no longer fit to run the company. In April 1990 Lifland appointed Martin Shugrue, a former executive at Pan Am and Continental, to take over Eastern as its trustee.

A friendly, personable man, Shugrue made a valiant effort to save Eastern, even starring in a series of television commercials intended to convince the flying public that Eastern was back and better than ever. But circumstances he couldn't control—the recession, fear of flying during Desert Shield, exorbitant fuel prices, and negative publicity—prevented Shugrue from steering the company back to financial soundness. Instead he went repeat-

MARK WEXLER

Grounded in California's Mojave desert, remnants of Eastern's fleet await a buyer.

edly to court, requesting millions of dollars from an escrow account to keep Eastern afloat. With Eastern's angry creditors clamoring for the company's liquidation, Shugrue finally threw in the towel.

A month after Eastern shut down, its most valuable assets were auctioned off. Delta, American, Northwest, United, and Continental all acquired Eastern's gates and slots at various airports. Immediately following the auction, smaller items and memorabilia were put up for sale to the public—everything from silverware and flight attendant carry-on bags to first class china and liquor. In the three years since the shutdown, most of Eastern's more than 100 aircraft have been sold to a variety of foreign and domestic carriers or returned to their owners. Shugrue still works for the Eastern estate, overseeing the disposition of the remaining assets and the settling of creditors' claims. (The estate has already paid out over $150 million in severance and vacation pay, as well as $50 million to a retiree health trust.)

There are many lessons to be learned from Eastern's demise, which was certainly one of the most bitter and catastrophic business failures in U.S. history. But this story isn't about what went wrong: it's about what happened next. What do people recall about the moment Eastern disappeared? How did the corporate death change their lives? What did they lose and what did they learn? Three years later, how successful have they been at moving on?

On the day Eastern shut down, Nancy Price, a national sales manager, told her luncheon audience of some 400 members of Travel Agents International in Las Vegas not to believe everything they read in the *Wall Street Journal.* What they had been reading in the past few weeks, not just in the *Journal* but in practically every major daily in the United States, were increasingly ominous rumors of the airline's fast approaching death.

Like many Eastern employees, Price had given that particular speech before, but she still had faith in the company's future. She had been with Eastern for 13 years, long enough to know what it had once been. The airline had weathered one of the bitterest strikes in labor history, been bought out, and was now operating behind a shield of bankruptcy. But almost everyone in the company was now working harder than ever, convinced that the worst was over and the airline's tattered glories could one day be restored. Price's audience were solid Eastern boosters, and the pep talk

got the usual polite applause.

When Price called her office in the middle of the afternoon, it was already 6 p.m. at Eastern's Miami headquarters. Before she had left for Nevada there had been a lot of talk about yet another shakeup, but her boss had told her, "You don't have to worry about your job because I understand what's going to happen will be [to] directors and above." But now, when Price reached her secretary, it was obvious she was crying.

Controlling her shock over the news from Miami, Price returned for another session with the travel agents. She was scheduled to draw the winner of an Eastern Air Lines promotional raffle and decided to go ahead with it. "I have some good news and some bad news," she announced. "The good news is that the winner receives first class tickets anywhere that Eastern flies in the United States. The bad news is that as of midnight tonight, Eastern Air Lines will cease to fly."

Price went on to thank the travel agents for their past support, and told them what they could do to protect their passengers and minimize their own liability. When she finished, the audience gave her the first standing ovation of her career. She jokingly told them that her résumé would take the place of the regular Eastern ad in their next newsletter. Anyone with a job offer, she added, could find her at the bar.

Earlier that day, Eastern captain John Gurl arrived in Boston on his way home from piloting a three-day trip. He too had heard rumors of a new shakeup, and when he arrived in Boston he headed to the operations center for an update. A number of other pilots and ground personnel were huddled in groups listening to radios and waiting for the phone to ring, but all the news was about the Gulf war and no one seemed to know any more about Eastern than he did. Gurl was exhausted, so rather than join the vigil, he got into his car for the hour's drive to his home in New Hampshire.

When he arrived he finally got the news. What on earth was he going to do? The shutdown couldn't have come at a worse time. He had invested heavily in real estate, and with the recession, property values were at a five-year low. Moreover, two years earlier he had bought himself an expensive new house, just weeks before his union, the Air Line Pilots Association, asked its members to strike in sympathy with Eastern's striking machinists. He didn't draw another paycheck until May of 1990, and for 15 months only the prospect of his being recalled to flying had kept his creditors at bay.

Eight months after resuming work, Gurl still hadn't regained his financial footing, and with the company gone, he no longer had a story for the bank. Equally serious, he was 52, and in a profession where retirement is mandatory at 60, he knew he'd probably never fly again. He looked out the window into the New Hampshire winter's night. He felt as though he were eight years old again and suddenly naked.

MICHELE MCDONALD

Former Eastern pilot E.J. Breen now owns and operates a pizza parlor in Salem, Massachusetts.

A seasoned airline executive, Martin Shugrue was the man many believed could turn Eastern around (opposite).

Martin Shugrue is a former naval aviator who started his airline career as a flight engineer with Pan Am. He left nearly 20 years later as vice chairman and chief operating officer to become president of Continental. At that time, both Continental and Eastern were controlled by Texas Air chairman Frank Lorenzo. Shugrue stayed at Continental a year—until Lorenzo replaced him with an executive from TWA. Remarkably, Shugrue and Lorenzo remained cordial at their parting. Little more than a year later, Shugrue became Eastern's trustee.

By then Eastern was in terrible shape and most outsiders didn't expect it to live another 30 days. But Shugrue is a tough, lean pragmatist and one of the most forceful positive thinkers in the industry. "The first year was chaos," says Shugrue, "trying to save it, working 20-hour days seven days a week to try to keep it intact, keep it alive, keep it flying." Shugrue believed there was still a chance of deliverance, and he was able to sell that vision in bankruptcy court.

One of the many reasons he still had hope for the beleaguered airline was his long friendship with "E.J." Breen, an Eastern pilot who had coordinated his union's strikes and been one of Eastern's chief tormentors. Shugrue and Breen had shared a cockpit in the Navy, and Shugrue had even been an usher at Breen's wedding. When he looked at the familiar face across the conference table at their first official meeting, Shugrue had heady visions that they would be able to "make peace in the family."

In January 1991, declining seat sales and increasing pressure from creditors, along with the disastrous impact on fuel prices of Iraq's invasion of Kuwait, finally forced Shugrue to pull the plug. Of the day Eastern ceased flying, Shugrue says it "may have been the worst business day of my life." When asked who he feels was responsible for the carrier's downfall, he says, "I've been asked to observe on that since I've been here, and my earliest response was: 'A pox on both their houses.' There's blame enough in this disaster to be spread everywhere: Lorenzo, the management, the unions, the government, everybody. Everybody watched this thing disintegrate and did nothing to save it."

Although Shugrue never made the

After the 1989 strike, office workers Nancy Price (left) and Pat Sharkey were put to work laying carpet in 727s.

peace he wanted, for many of its employees Eastern is still a family, with all that the word implies: loyalty and love, betrayal and disappointment, hope and despair, life and death. And perhaps most of all, hatred and forgiveness.

"Ask anyone at any airline and they'll tell you the same thing. We all had friends that we worked with during the day, socialized with nights and weekends. It was family," recalls executive secretary Pat Sharkey, who started in 1976 and now works for the Eastern estate as Shugrue's assistant. As with any other family, the bonds between its members were tested and often strengthened in deep adversity.

After the company filed for bankruptcy in 1989, Sharkey and a number of other employees who were neither union nor management were assigned to the hangar, given coveralls and steel-toe shoes, and put to work laying carpets in the airplanes that were being sold to the Trump Shuttle. "We worked harder than we've ever worked in our lives," she says, "from six in the morning to six at night, six days a week. I went home so dirty, sweaty, and disgusting I'd leave my clothes by the garage door before I stepped into the house."

On her first day at the hangar she met Nancy Price, who had been transferred to the same assignment from her job in sales. "I never knew her before, but we just made such wonderful friends," says Sharkey. "We were taken from jobs we knew to ones we had never done before, and it was very hard work. I was scared half to death to get on those 12-foot ladders, but sometimes we had to unscrew the flap panels on the wings. I didn't feel very good about it the first week, but Nancy kept me going."

At the height of the chaos after the shutdown, Eastern opened an employee hotline, staffed by 32 holdover workers, to answer questions about issues like sick leave, health benefits, disability allowances, vacation and severance pay, pensions, and unemployment insurance. In the first two weeks after the airline ceased flying, they received over 70,000 calls. Three years later the staff is down to two, but the calls are still coming in.

"In general, they're very nice and they appreciate the information we give them," says vice president of employee relations Al Gibson, who still works for the Eastern estate. "We get some cynics, especially among those who struck and never came back, who feel kind of burned and betrayed. And some callers start to discuss the question of blame, usually laying it on the unions rather than the company. We don't want to get into the middle in either case; we try to focus on where we're at."

Two days after the shutdown, Florida opened a Dislocated Workers Assistance Center on the north campus of Miami-Dade Community College. Ten months and two moves later, the center took over the building on 36th Street that had been occupied by Eastern's reservations division. The timing was perfect. A few days afterward, the building's next-door neighbor, Pan Am, followed Eastern into oblivion.

B.J. Rakow, the center's director, says no records were kept of where their more than 17,000 clients had worked, but she estimates that more than 6,000 had worked for Eastern and about the same number for Pan Am. The remaining four or five thousand were also mostly from the airline industry. "Midway went down, Braniff went down," she says. "But on top of that we were serving dislocated workers from other industries. Jordan Marsh, a department store, disappeared, and then there were all the banks that either merged or fell apart."

The assistance center provides a variety of employment, training, and support services, including recruitment calls and worker screening. In the first two years, 60,000 such services were performed at this one location, approximately 20,000 of them for former Eastern employees. Rakow estimates that about half the airline workers have managed to relocate within the industry, but almost none with salaries or responsibilities comparable to what they had. "I know that people who were supervisors and managers are happy to get jobs as ramp agents and in-flight service," says Rakow. "And of that 50 percent still in the business, a lot had to go outside south Florida to get their jobs."

When an airline goes under, not all of its parts die at the same time. One of the more durable extremities is the department responsible for lost baggage. After January 18, three of Eastern's baggage managers were asked to stay on to deal with the thousands of claims that remained unresolved. Linda Herbits, who had worked 10 years for Eastern in Chicago, five in Boston, and nine in Miami, stayed with the airline until the following August, when she took a job at a local university for half her former pay. She missed the pace of her old job almost immediately, and she began to send out her résumé again, this time to the airlines.

American answered her query the following December. Herbits was at work, but her husband Chuck, an at-

Linda Herbits (at home with husband Chuck) now works in the cargo division at American Airlines.

torney, took the call. "They offered even less than she was making at the university," he says. "It was a menial, entry-level job. And it started the next morning at 8:00 o'clock. I knew what Linda wanted, and I never hesitated for a moment [to tell them yes]." Thrilled at the news, Herbits called her boss at the university and said she didn't work there anymore.

But the new job she went back to was nothing like the one she had left four months earlier. As a baggage handler, she was on the ramp every day. "By the end of the first hour I had no fingernails left. My back hurt in the morning. I'd wake up and be swollen and stiff because I'd been grabbing all day long."

Seventeen months later she moved up to an office job and the torment ended. But she says that if she were told to put her uniform back on and return to the ramp tomorrow, she'd do it.

Psychologist Enrico Suarez helped Eastern pilots cope with the stress of losing their jobs.

After working 21 years at Eastern, Edie Maye Manson became a guidance counselor.

Other Eastern employees, however, didn't mind walking away for good. Edie Maye Manson had worked in reservation sales for 21 years and was out the door the day Eastern closed. The loss of her job hit her in the pit of her stomach, reminding her of the death of her father 10 years before. Fighting the hurt, she invited a co-worker, a single woman with a young daughter, to move in with her and share the mortgage and the electric bill. She had taken college courses for years, earning a degree while working with Eastern, and now that she was unemployed she continued taking courses toward her teacher's certification.

She was out of work for seven months, and when her unemployment insurance ran out she began training to become a Social Security representative. She hated it and quit, unaware that the Dade County school system was trying to reach her with a job offer. A week later, she began a new career as a guidance counselor, becoming one of the few Eastern workers who is now getting a higher salary. She's not surprised. She has a lot of faith.

"I felt confident that God didn't bring me this far to leave me," says Manson. "I start each day saying, 'Lord, I know there's nothing going to happen that you and I can't accomplish together.' And the day goes so well. I survived."

Enrico Suarez, a psychologist retained by Eastern as a crisis management consultant, shares Manson's belief in the value of a positive attitude. After the shutdown, he ran 24 weeks of support groups pro bono for Eastern employees, trying to help them cope with the intense emotions they felt. Al Gibson, the former vice president of employee relations, observed the hatred that many of the pilots felt toward Lorenzo. "They were going to kill Lorenzo no matter how many people they took in the wreckage," says Gibson. "It clearly was a case of make Lorenzo the issue and get him

Death Watch

1975 Apollo 8 astronaut Frank Borman, named president and CEO of Eastern Air Lines, sets an aggressive growth course.

1976–1979 Eastern generates $363 million in operating income.

1979 The Airline Deregulation Act phase-in begins.

1980 People Express begins New York-Florida service at $49.

1982 Texas International, led by Frank Lorenzo, acquires Continental Airlines.

1982–1984 Eastern loses nearly $300 million.

1983 Continental's machinist union strikes. Lorenzo puts Continental into bankruptcy under Chapter 11 and abrogates union contracts.

1985 Frank Borman begins search for a buyer.

February 1986 Borman says that unless Eastern's unions agree to a 20 percent wage cut, he will be forced to sell the airline to Lorenzo. Charlie Bryan, president of the local district of the International Association of Machinists, refuses.

September 1986 Continental emerges from Chapter 11 as a non-union, low-cost carrier in good financial health.

November 1986 Texas Air Corporation buys Eastern.

1987 Ten percent of the Eastern workforce is laid off. On February 1, Lorenzo merges Frontier, New York Air, People Express, and Continental into a single airline.

March 1989 The IAM, led by Charlie Bryan, goes on strike at Eastern. Nearly all pilots and flight attendants honor the picket lines. Eastern files for Chapter 11.

November 1989 Eastern pilots and flight attendants call off their strikes.

December 1989 Eastern announces a loss of $900 million.

1990 Recession causes drop in passenger traffic.

April 1990 Bankruptcy court deems Texas Air unfit to run Eastern; Martin Shugrue is appointed trustee.

August 1990 Iraq invades Kuwait. Jet fuel prices double. At Continental, Lorenzo steps down.

November 1990 Eastern's creditors move to have the airline liquidated. Judge Burton R. Lifland instead grants Eastern another $30 million from escrow to continue operating.

December 1990 The airline industry announces a record loss of $4 billion.

January 1991 Eastern announces that it has ceased flying and is liquidating its remaining assets.

out, make him sell the airline. Prior to the strike, the pilots were saying 'Job security.' After the strike started, the motto shifted to 'One day longer than Lorenzo.' "

"I tried to show them the psychology that had created that strike," says Suarez. "We talked about people who got so much into hate and animosity that they all in effect put a gun to their own heads and pulled the trigger. Overall, I think most people did quite well. There has been a tremendous amount of adaptation."

Most of the pilots who consulted with Suarez after the closing avoided the support groups and saw him privately. Several of those he has kept in touch with are now flying for airlines in Asia; in most cases, their careers in the mainland United States are over. One pilot who had started law school before the strike is now an attorney. A DC-9 captain is finishing his training for a career as a radiation therapist. Others are working at jobs ranging from corporate management to private detective work.

One of Suarez' alumni is Captain Douglas Palmer, a pilot who struck and then returned to work—prematurely, from the union's viewpoint. His name is on a scab list of pilots described by its compiler, E.J. Breen, as "tattooed for life." Palmer spent several months flying freight and charters for Evergreen International Airlines in Oregon and later helped some 30 Eastern pilots, some of whom were on Breen's list, get hired at Evergreen.

Palmer is now co-founder and director of operations for Branson Airlines, which operates 50-passenger de Havilland

Former Eastern pilot Doug Palmer is co-founder and director of operations for Branson Airlines.

Dash-7 turboprops in the central states and between Florida and the Caribbean. The lessons he learned from Suarez have become the credo that drives his hiring policy.

"It makes no difference to me whether a man went on strike at Eastern or didn't—all I'm looking for is good people," says Palmer. "Everybody did what they felt they had to do, and in the end we were all losers. And you have to pick up your life and move on. It's been hard, it's been interesting, and it's been a lot of fun. I'm very, very happy."

Berton Beach spent 33 years at Eastern, most notably as director of flight training. He describes himself as "most fortunate" to be holding exactly the same position with Flight Safety International, the company that purchased Eastern's training facility. He echoes the same philosophy as Palmer, and like him went through Suarez' program.

"I wouldn't want someone working here who felt he had an ax to grind," says Beach. "It's possible that striking pilots who now work for other carriers will be taught by people who were not striking pilots, and the opposite may also happen. I hope so. Past history means nothing to us as long as they're qualified to do their jobs and don't carry any [emotional] baggage."

Others haven't been as fortunate as

Palmer and Beach. "A lot of good people got hurt financially," says George Boles, who worked as Eastern's director of purchasing. "A lot of people committed suicide. There was one guy, I knew his father. And the father had worked 40 years for Eastern before he retired. This guy's wife worked for Eastern as a flight attendant. She committed suicide, and a short time later, he committed suicide. The papers said she was depressed from Eastern going under. I don't know. But there were a lot of other suicides and a lot of divorces. It was a very hard time for a lot of people." Since the shutdown, an estimated 38 Eastern employees have killed themselves.

Not surprisingly, the bitter feelings remain. "I haven't talked with Lorenzo in years," says Al Gibson, who still works in an office in the nearly vacant tower that once was Eastern headquarters. "But I can guarantee you Frank Lorenzo sleeps well at night. Frank Lorenzo hasn't missed a meal. Frank Lorenzo has plenty of money in the bank. And those poor people who were taken out in this debacle—there are ruined lives. I can't relate to you the number of people with personal travails."

(Lorenzo himself has been affected by the death of the airline he once owned. Last September, after months of opposition from labor unions, Lorenzo's bid to start a low-cost carrier was initially rejected by a Department of Transportation-appointed judge.)

The striking Eastern pilots who never crossed the picket line received psychological support through their union and a counseling group at the University of Virginia. But taken in the aggregate, it would be safe to say that they are nowhere near as happy as Doug Palmer or as fortunate as Bert Beach.

E.J. Breen, who once struggled against Eastern as the pilot union's strike coordinator, now finds himself squaring off against the union. According to Breen, union leaders promised him and his fellow pilots that if Eastern were fragmented or liquidated and any assets went to another carrier, Eastern pilots would go with them—with seniority. "To date, not one pilot has gone," he says. "We have 2,500 members in a class action" lawsuit against the Air Line Pilots Association. "The whole thing has been an emotional roller coaster and we've been in and out of every court in the land." He is sorely disappointed with union leadership. "As a result of what I've sacrificed," says Breen, "I'd like to see ALPA turned around. I'd like to see the pilots realize just how weak and how feeble and self-centered their leadership is. Of these 2,500 pilots, ALPA dumped on every single one of them in the end. And that's sad."

For all that, Breen says he wouldn't have done anything differently. "I don't think we had any option. Once Lorenzo got hold of the airline, the airline was gone—we decided we were going to take him down with us. People are always going to have to work together to insure that people like this are not suc-

Charlie Bryan has no regrets about leading the strike against Frank Lorenzo (left).

Denise Noe, director of Eastern's customer service training, has opened a restaurant in Miami filled with company memorabilia.

cessful. Because without it I think you have anarchy."

Breen has pretty well resigned himself to the likelihood that his own flying career, like those of so many others, ended with the death of Eastern. To support himself, Breen owns and operates a pizza parlor franchise in Salem, Massachusetts.

Breen isn't the only strike leader whose relationship with his union has changed dramatically since Eastern disappeared. Charlie Bryan joined Eastern in 1956 as a mechanic and rose through the ranks to become one of the most famous and charismatic icons in American labor. In 1980 he was elected president of District 100 of the International Association of Machinists; four years later he had gained a seat on Eastern's board of directors. He even succeeded in running another American icon out of the company: at the peak of his power, Bryan unseated Eastern's president, former Apollo astronaut Frank Borman.

A former Eastern pilot, Joe Dominguez now flies for the USAir Shuttle.

In *Countdown*, his autobiography, Borman reports that in 1986 the airline was in a precarious financial position and often on the brink of bankruptcy. Borman knew he had to cut labor costs, and he managed to get both the pilots' union and the flight attendants' union to agree to 20 percent wage cuts. But if he didn't get the same concession from the machinists' union, he'd be forced to sell the airline to Frank Lorenzo, who had made an offer. After hours of tense negotiations, Bryan agreed to a 15 percent wage cut if Borman would step down. Amazingly, Borman agreed to leave, but only if Bryan would go along with the full 20 percent concession and thus keep Eastern out of Lorenzo's hands. Bryan, however, never budged from the 15 percent concession. Eastern was immediately sold to Lorenzo, a sale that eventually resulted in thousands of IAM members losing their jobs.

Today Bryan has at least one thing in common with his old nemesis, Frank Lorenzo; he hasn't missed a meal or suffered serious financial hardship as a result of Eastern's death.

Bryan still lives in the same house he bought 35 years ago near Homestead, Florida. Last fall, when Hurricane Andrew passed over Homestead, his house suffered extensive damage: the roof was battered, and the bedroom and garage destroyed. But in an area where hundreds of houses were completely demolished, Charlie Bryan's stood up to the storm. He did most of the repairs himself and moved back in this spring. On the heels of the storm, however, the union he served for so long eliminated his district, putting him out of work.

"The truth is you don't have a major strike like that unless almost everybody is on board," he says. "It doesn't matter to me whether they blame me or not. Despite the work I've done, I've always been very much of a loner. I grew up poor, and I'm still a peanut butter and jelly guy and a Burger King guy. I'm not disappointed. I don't feel negative, and certainly not sorry for myself. I already went far beyond anything I ever expected."

At the time of Eastern's demise, the company had assets worth about $1 billion, although it owed its creditors more. There will probably never again be another carrier that comes apart with so much value in its route structure, equipment, and systems.

There are large companies today with far weaker asset bases, and like Eastern in 1989, their management and labor are on a collision course. But because of what happened to Eastern, some of those companies will probably survive. Richard Blake, the airline's vice president of marketing who now works for a cruise line in Port Everglades, says that Eastern has become a cautionary model for the consequences of deep, unyielding division. "People realize they can still take hard positions, but I think they're less likely to lead their union or their company over a cliff," he says.

Michael Jones, head of Eastern's inflight services, says a community like Miami suffers in ways that aren't easily measured when it loses an industry giant. In 1986 Eastern had 12,000 employees at its Miami headquarters and about 8,000 in Atlanta. With the loss of much of top management, basic civic leadership has simply moved on.

And as long as airlines are treated as commodities, he thinks the hard times will continue. "The capital investment required to be a player in this industry is too immense to foster a free market entry and low prices," says Jones. "Airlines are not commodities, but a service along the lines of a utility, and they should be semi-regulated and protected accordingly. Deregulation is the event that turned it into a commodities business, and prices will go back up once excess capacity is squeezed out of the market."

All that may sound a trifle abstract to Eastern's ex-captain John Gurl and former sales manager Nancy Price.

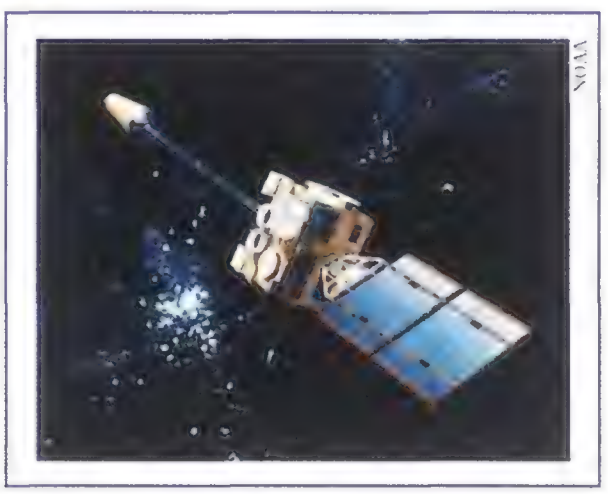
Price now has a similar job, but outside the airline industry and for a much smaller company, selling telephone systems to cruise lines. She enjoys her job, which allows her to report directly to the company's president. And she's grateful for Eastern's training—glad that she was still young enough to start over. But two and a half years later she's still not up to the salary she made after her 13-year climb up the ladder at Eastern. The failure of the first company she ever worked for, she says, is the most devastating thing that ever happened to her.

On the advice of a friend who specialized in bankruptcy law, John Gurl sold his new home at a loss and literally went south—to Florida—abandoning his investment properties to the creditors. When they were gone, he returned. A friend lent him the down payment for a small condominium in a town near his old estate.

He has started his first job since Eastern Air Lines died. He sells rebuilt cartridges for computer printers.

MARK WEXLER

BLUNDERSAT



Even if the new improved weather satellite becomes the best thing NASA and NOAA ever sent up, they'll never live it down.

by Frank Kuznik

Marty Davis is the type of manager you like to imagine at the helm of all NASA projects—a solid pro with 31 years' experience in the business, tough-minded, dedicated, and above all, a good soldier. In the spring of 1991 Davis had just completed a job as instruments manager on the grandly successful Compton Gamma Ray Observatory when he ran into his friend Rick Obenschain, another NASA manager, in the hallway at Goddard Space Flight Center in Maryland.

"I don't know if you'll talk to me after this," Obenschain said, "but I asked for you on GOES."

"I really didn't know much about GOES," Davis recalls. It didn't take long to find out that the latest series of weather satellites was one of NASA's most troubled programs—two years late, unconscionably over budget, and under heavy fire from Capitol Hill. Within months of Davis' appointment as GOES instrument systems manager, a Senate subcommittee asked President Bush to declare a national emergency because the GOES delays were jeopardizing the National Weather Service's ability to forecast dangerous storms. At the same time Secretary of Commerce Robert A. Mosbacher, whose agency oversees the National Oceanic and Atmospheric Administration, commissioned a panel of experts to recommend what action NOAA should take to extricate itself from the tangled program.

"I'd never seen a mess like this before," says Davis of his initial reaction. "To be perfectly honest, I didn't know we owned a mess like this. It was an embarrassment to Goddard, and I wanted to see what I could do to help."

Davis, 54, went to the heart of the beast: ITT Aerospace/Communications in Fort Wayne, Indiana, where the delicate instruments designed to photograph and measure weather patterns from 22,300 miles up were mired in a hopeless technical snarl. For the next two years, he spent most of his time in Fort Wayne, far from his wife and his Maryland home, as he orchestrated a massive effort to produce the instruments for NOAA's series of advanced Geostationary Operational Environmental Satellites. Finally last May he shipped to Space Systems/Loral in Palo Alto, California, the two instruments for the first satellite: an imager to take the cloud pictures shown on the news every night and a sounder to take temperature and moisture readings that forecasters analyze to determine when and where storms are likely to form and how long they will last. Space Systems/Loral installed the instruments on a satellite, tested the system, and

NOAA considered scrapping the new GOES satellite (above), which is now expected to outperform its predecessors.

If GOES 7 hadn't sent a warning in 1992, damage caused by Hurricane Andrew could have been deadlier.

PAT FARRELL/MIAMI HERALD

shipped it to Florida to launch next April. By all estimates, when that satellite, GOES I, begins sending data, meteorologists will enter a new era of weather prediction and understanding.

"Everyone thought this was a natural progression of previous work," says Davis. "It's not. The manufacturers still can't meet spec on some of the detectors for the sounder. In other words, it's beyond the state of the art."

The story of GOES is an engineering Aesop's fable with a moral for those naive enough to think that they can push technology as far and as fast as they want. Apparently the critical need for the GOES satellites lulled aerospace professionals—contractors and clients alike—into believing that because something must be done it can be done.

The first GOES satellite was sent aloft in 1975; another six have flown since. For most of that time, two satellites have been positioned above the east and west extremes of the United States in orbits synchronized with Earth's rotation so that each appears to hover over its station. They serve as the sentinels of the weather service, the early warning system for hurricanes and other severe weather and the key to tracking and predicting storm movements. The National Weather Service has other forecasting tools, such as radar, radiosonde, and two polar-orbiting NOAA satellites (originally called TIROS for Television Infrared Observational Satellites) that fly overhead twice a day. But for continuous monitoring of cloud patterns and storms, GOES is essential.

"Without GOES, there are huge holes in the coverage," says Tom McGunigal, head of NOAA's systems program office. "The satellites knit all the other data together in a way that's irreplaceable." One need consider only a single set of statistics to appreciate the satellites' worth: In the 1970s, 995 Americans died in tornadoes; in the 1980s, the number of twisters remained constant but the death toll dropped by half. The National Severe Storms Forecast Center in Kansas City, Missouri, credits GOES.

In 1985 NOAA contracted, through NASA, for a set of replacement satellites, which the agencies referred to as GOES Next. Ford Aerospace (later bought by Loral) would build the satellites with ITT as subcontractor for the instruments. Ford and ITT had solid track records; they had recently collaborated on INSAT, a successful communications and weather satellite for India. Moreover, Ford had built the first set of GOES satellites, and ITT had built the instruments for TIROS.

Still, the new satellites posed a significant challenge. For one thing, the previous GOES had been stabilized by being spun in place, like a top. Though efficient, spinners look away from Earth 95 percent of the time—a poor design for continuous monitoring. The new satellites are "three-axis" models that stare at the planet constantly, kept in place by thrusters and servo units, a much more complex system that places stringent demands on both the spacecraft and the instruments.

The previous GOES had only one instrument, a combined imager and sounder. NOAA had regarded the sounder as an experiment; imaging was the better understood and more frequently used capability. GOES Next will change that. On these satellites, the functions have been separated into two instru-

SCOTT HIGHTON

Marty Davis spent two years getting the first set of optical instruments ready for testing at Space Systems/Loral.

SPACE SYSTEMS/LORAL

GOES I and J are next in the series of geostationary weather satellites that have stood sentry over the United States since 1974. For most of the past 20 years, starting with two Synchronous Meteorological Satellites (SMS) launched in '74 and '75, NASA has kept two satellites operating in concert. But a launch failure in 1986 left GOES 6 to work alone for a year, and in 1989 GOES 7 went solo. A European satellite has filled in for the missing GOES since 1991.

SMS II found simultaneous hurricanes in 1980 (below, left). GOES 7 recorded the size of the blizzard of '93.

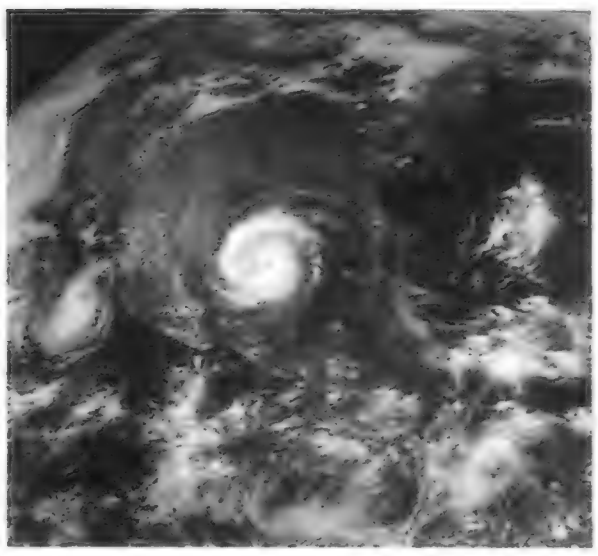
ments, a significant upgrading that enables imaging and sounding to be done simultaneously instead of on a timeshare basis.

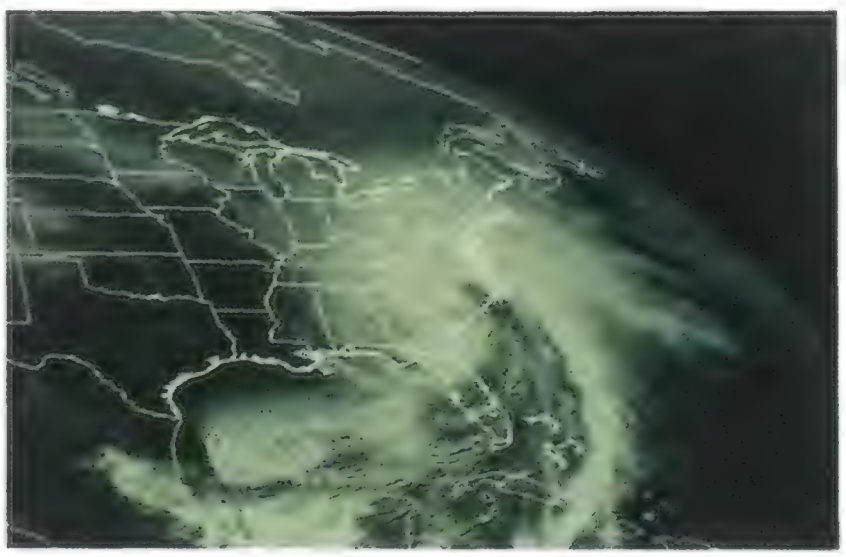
In addition, the new imager and sounder have more data channels (19 on the sounder alone), both visible and infrared, as well as greatly enhanced pointing and scanning capabilities. "With our old satellite we generally advertised an earth location accuracy of around 10 kilometers [six miles]," says Ron Gird, satellite program leader for the National Weather Service. "With the new one, we're advertising two to four kilometers." The resolution of individual pixels—the elements of visual information that together make up the whole picture—will improve from eight kilometers to four kilometers. The new satellites also have the ability to zoom in quickly on developing trouble spots.

"From our viewpoint the new GOES represent a big jump, in that we'll be able to look at storms more frequently and see their beginning life cycles sooner," says Gird. "That will mean better forecasts and warnings for thunderstorms in particular, which we'll be able to pinpoint and time more precisely."

Despite the new satellites' complexity, no one at NOAA, NASA, or either of the contractors expected problems meeting the original July 1989 launch deadline for GOES I. No one looked closely enough. Almost a decade after the order was placed for the GOES replacements, series I through M, not one has made it to orbit. In January 1989, GOES 6, one of the two satellites then monitoring the United States, died. NOAA repositioned the remaining satellite, GOES 7, over the center of the country, where it was able to provide adequate though narrowed coverage. It took two years to arrange a backup. Had GOES 7 died during that time, the severe weather warning system for the entire country would have been blind.

The GOES difficulties began when NOAA, believing the previous GOES and polar orbiters had laid the groundwork, decided to spend all its available dollars on flight hardware. The agency proposed omitting Phase A and B engineering and feasibility studies, which are normally done on new projects. Those studies validate technical requirements and instrument design and identify precisely the type of problems that later came to plague GOES. Arthur Schwalb, then head of the NOAA-NASA liaison office for weather satellites, says that no one in either agency at the time "was uncomfortable with the decision to proceed directly to procurement." Today a lead engineer at Mitre Corporation, an aerospace consulting firm, Schwalb says that "obviously, the more you study the systems,





NOAA (2)

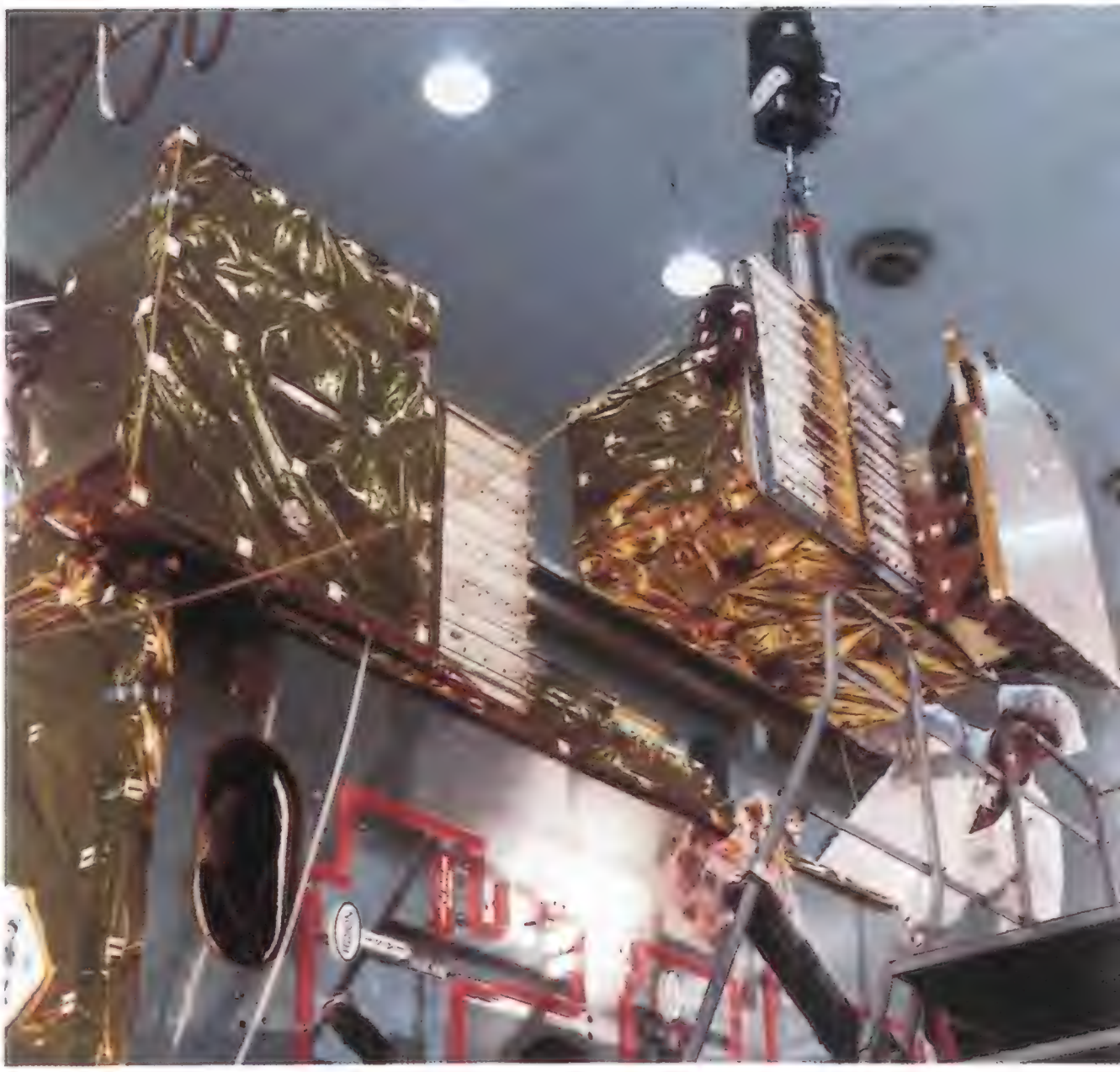
the better prepared you are to understand any difficulties in development," but he adds that the contractors already had a large amount of experience and had conducted a number of studies of future weather satellites.

"Enormous trust was placed in ITT, based on their experience building the instruments for the TIROS and INSAT satellites," says NOAA's McGunigal. "But there were huge differences between those designs and what we required. And quite frankly, ITT just wasn't up to the task. They had built the high-resolution infrared sounder on the polar-orbiting satellites. But they orbit at 500 miles. You don't have to worry when you have all that radiation flooding the detector. In an instrument 22,300 miles away from the atmosphere, you have a much greater challenge." According to McGunigal, the instrument designers assumed that by increasing the size of the telescope's aperture, they could admit more radiation—both infrared and visible—and so compensate somewhat for its increased distance from the atmosphere. But they underestimated how much electrical noise the instrument itself would produce, as well as the difficulty of making infrared detectors that could react to very small differences in the energy level of radiation striking their surfaces.

If there were any second thoughts about shortcutting the normal development process, they were brushed aside in May 1986, when GOES G was lost in the failure of a Delta rocket during a launch from Cape Kennedy. That left the United States with just one GOES satellite in the sky—not an unprecedented situation, but one that demanded the new series be delivered fast.

The pressure to launch put the program in a straitjacket. Rather than stopping to do the planning and testing that were bypassed up front, NASA and NOAA officials focused on specific glitches, hoping each would be the last. Electrical engineers, for example, had wired the instruments with nickel, which is subject to changes in resistance at extreme temperatures. Once the engineers realized that the wiring was causing the signal drift and blurred images in tests, it was changed to constantan. But other problems surfaced. The imager's scan mirror warped during thermal vacuum tests. ITT redesigned the mirror, but problems persisted in the servo and pointing systems. One problem led to another, bumping the launch date always just beyond reach.

SPACE SYSTEMS/LORAL



ANDREW JOHNSTON

GOES I gets its sounder. Thermal control louvers protect the scan mirror; a square of solar reflectors radiates heat away from the detectors. ITT's Paul Lisi (left), says developing the instruments required a focus on performance instead of schedule.

"Certainly the schedule pressure that was on the program from day one was not a very healthy situation," says ITT's GOES program director Paul Lisi. "We were sort of tripping over ourselves for several years trying to get a product out to launch."

The number of people working on the project grew, as did the cost, which now stands at $1.1 billion—more than twice the original budget. "NASA did all the classic things," says Rick Obenschain, who is the GOES project director at Goddard, the project's contract administrator. "We applied more visibility, put more money into it, put more people on it—I think at one time we had 300. But you can't do that on in-

struments. You can't just throw more people at them." Indeed, a favorite saying among project insiders was "Nine women can't produce a baby in one month."

Space Systems/Loral president Robert Berry says SS/L first became concerned about ITT missing deadlines in 1988. However, an internal NASA memorandum on the GOES contract history shows the subcontractor was in trouble well before that. An entry for August 1987 reads: "Becoming clear that complexity of job was underestimated. ITT in over their heads."

The major problems with the instruments centered on the detectors, nerve centers that measure brightness at various wavelengths and convert these measurements into electrical signals that can be processed and sent to the ground. The sounder has 12, each of which must be carefully aligned for peak performance, a process akin to balancing a pin on its point.

In the middle of producing instruments that were a quantum leap forward, ITT lost many of its senior engineers to a Strategic Defense Initiative program. The company replaced them with enthusiastic but dismayingly young talent. "When we went to ITT in 1988 it looked like they had the '87 graduating class from Purdue working there," says Berry. At one point the average experience of ITT engineers working on GOES was shorter than the time the company had had the contract.

When Marty Davis first arrived at ITT in July 1991, he was surprised by the crisis atmosphere he found. "It was a philosophy I'd never seen before," he says. "Work, work, work, no matter how correct you were or what track you were on. People were being called in at all hours for problems they didn't understand. There was no experience, no gut feel for what it takes to make flight hardware. It was just a different world."

One of Davis' first actions was to stop a test because it was impossible to distinguish the instrument's output from the background noise generated by a sloppy test set-up. "I said, 'We're going to clean up this rat's nest of a test facility,' " he recalls.

Today, Davis says of the program, "There's no magic solution to a screw-up like this." As he pushes open the door to a company test lab, he elaborates: "You just peel the problems back one layer at a time, like an onion, and see what improvements need to be done."

Mounted on a large granite workbench in a clean room behind a glass wall is the sounder that will fly on the second satellite, GOES J. The instrument is nearly hidden beneath a snarl of wires and tubing and a cooler clamped on to simulate the freezing temperatures of space. "We're peaking the detectors," Davis explains, nodding toward technicians checking digital readout displays. "Peaking" is a matter of moving the face of each detector incrementally in three different planes so that the maximum amount of light will strike the surface. It's like focusing the lens of a camera, but it takes 16 days.

"We're doing this now in less than half the time they used to," Davis says. "That's one example of how to make improvements. Of course, a problem like this [test] wouldn't even have been considered a problem two years ago; it was too small. We had much bigger problems."

NASA management, embarrassed by the program's delays, was pressuring the contractors to meet a launch deadline. Davis recalls that the sounder had been out of the test chamber for about a week—as a result of his effort to improve test procedures—when the agency's then-deputy administrator J.R. Thompson flew out for a visit. "He came to see me one morning and said, 'You know, you're slowing things down. How much longer are you going to be out of the chamber? You've got to get on with it!' I said, 'We will, when it feels right.' And he said, 'When is it going to feel right?' and I said, 'I don't know. I agonize over that, but I don't know. When it feels right, we'll go back in test.' It took another two weeks until I felt we were ready."

With the program in knots, NOAA officials began to explore other options. One was to buy another of the previous generation GOES, which were built by Hughes Aircraft. But delivery would take three years, and completion of the new satellite always seemed closer than that. (In early 1988 NASA had decided not to dump the Ford-ITT team for the same reason.)

Fortunately, the European Space Agency had a spare weather satellite in orbit and agreed to share coverage with the U.S. weather service. The Meteosat agreement was signed in October 1991, alleviating the danger of total blackout. It now watches over the eastern half of the United States while GOES 7 covers the west.

Just before the agreement was made formal, a study group of nine satellite

Sounding by Satellite

The GOES sounder is an optical instrument, comparable to a telescope that helps astronomers analyze starlight by separating it into a spectrum, a continuum of wavelengths. At infrared wavelengths the GOES sounder measures the intensity of radiation emitted by molecules in the atmosphere and by Earth's surface.

An atmospheric constituent—a molecule of carbon dioxide or water vapor, for instance—radiates energy in the infrared area of the spectrum. Molecules in the atmosphere also absorb radiation. The GOES sounder separates the radiation it receives into narrow bands, each corresponding to a different strength of absorption. Radiation channeled into the band that corresponds to the strongest absorption originates from the highest level of the atmosphere; radiation channeled into the band relating to the weakest absorption comes from Earth's surface and the lower atmosphere. The intensity of radiation in each band depends on the temperature of the atmosphere at the corresponding altitude.

To arrive at a temperature profile of the atmosphere, scientists first apply their knowledge of the atmosphere's fundamental processes to compute the radiation intensities that would result from a standard distribution of temperature. They then estimate the actual temperature distribution from the difference between the theoretical intensities and the sounder's measurements.

and instrument experts from around the country, chaired by Herbert Kottler of MIT's Lincoln Laboratories, delivered their ruling on the question commerce secretary Mosbacher had asked them to decide: Was the GOES program worth salvaging, or should the entire mess be scrapped and started over? The panel ruled in favor of keeping it, though with a critical change.

The actual imager and sounder, which had been under heavy pressure to fly, would be converted to the engineering models that were never done. That would give the contractors the time and experience they needed to build a set of flight-quality instruments—then those would be the first to fly. It meant delaying the launch date yet again, but this time with a realistic expectation that it could be met.

This wasn't the first time such a suggestion had been made. Shortly after he got to ITT, Davis called Goddard and asked, "Can I stop the program for two years and try to do this right instead of patching these things up?" But at that time Meteosat hadn't been secured as a backup. And the panel's ruling came at a time when an outside voice clearly carried more weight. "People were ready to listen to an independent committee," says Obenschain.

The decision didn't change the work pace, which continues around the clock, seven days a week, at both SS/L and ITT. But it transformed what had been a frantic operational program into a reasonable development program, with adequate time for testing. All of the problems became solvable—and with half the number of workers.

"That was the turning point of the program," says McGunigal. "The philosophy became: Surface every possible problem, get them all understood, then build the new instruments right—and that's exactly what we did."

But not without a struggle. Stung by other failures, NASA still wanted to remain on the old schedule, which had GOES I slated for an October 1992 launch. "Now Rick Obenschain knew as well as I did that it was hopeless," says McGunigal. "But the top managers wanted it. Make no mistake—when we redirected the program, we did so over serious objections at NASA at the highest level."

After Congress held hearings in summer 1991 to grill SS/L, ITT, and government officials on the GOES snafu, Ft. Wayne was flooded with outside help—from LERIS, Loral's optics division, from Lincoln labs, from other support contractors, from NASA and NOAA and virtually everyone else who thought they could lend a hand. "ITT was being overwhelmed," says Davis, who had to act as a referee, sifting out useful advice while trying to keep ITT morale propped up.

"It was a very, very difficult period," says ITT's Paul Lisi. "When we had a problem, instead of having a working meeting you'd have a committee of 25 experts coming in from all over the place, and you could never get anything done. An awful lot of our technical people started to become resentful."

Davis, caught in the middle, sometimes bore the brunt of the resentment. "I wanted more testing than ITT thought was necessary," he says. "They accused me, with my science instrument background, of trying to make a science fair project out of this."

"I'm probably one of the guys who said not to turn this into a science fair," admits Lisi. "It wouldn't take very much to wind up having nothing but a long test program with no end result ever happening. But I think Marty's served as a reasonable arbitrator."

Once Davis was satisfied that the instruments had been adequately tested, he shipped them off to SS/L—for more testing. "This was really the acid test," John Brown says with a nod toward a thermal vacuum chamber the size of a cement truck. Brown, the GOES technical director at the SS/L plant in Palo Alto, points out the modifications made to convert the chamber into a solar beam facility, which tests how well the imager and sounder will perform in the direct glare of the sun in space. An arc light simulates sunlight; a rotating in-

Five GOES are being assembled at Space Systems/Loral. All will receive optical instruments from ITT.

SCOTT HIGHTON

NOAA

strument mount duplicates diurnal and seasonal changes; a liquid nitrogen system drops the temperature to -308 degrees Fahrenheit. Fitting out the chamber and testing the pathfinder instruments cost $10 million.

The facility is empty now. After 12 days of testing early this summer, the imager that will fly on GOES I was moved to a huge clean room at SS/L and installed on the satellite.

"There were no surprises," Brown says. "We did find that the imager was running warmer than expected. So we made some improvements—very straightforward, like extending the sun shades—that we were able to prototype ourselves, go in and test, validate the design, and move on."

Which sounds simple enough. But setting up a solar beam test is no small task. "It took us ten months to get ready for those two weeks," Brown says.

By next May, ITT will send the instruments for GOES J; the following May, the instruments for GOES K, and so on. Everyone on the project, including Davis and Obenschain, has near-religious confidence in the reliability of the new instruments, and absolute faith that GOES I will lift off on schedule. "I'd take bets from anybody that we're going to launch on April 15," says Brown, sitting at a conference table with several other SS/L executives assembled to assure a reporter that GOES is going swimmingly.

Despite his faith in the satellite, Obenschain doesn't join the cheery talk. "When I took this job my charter was very simple—to launch GOES I in approximately 16 months and GOES J a year later," he says. "In October I'll be here for three years, and we still haven't launched a single spacecraft."

This is the only time in a 27-year career that Obenschain has worked on a program in which both early phase studies were skipped. Asked if he thinks NASA will ever skip both phases again, Obenschain answers with exasperation. "Well, in hindsight everybody knows you don't make a decision to skip early studies," he says. "Nor would anybody have launched a billion-dollar telescope with a faulty mirror. But I understand what the pressures were. You gotta remember one year after we made that decision, we had a launch failure and at the time everybody congratulated themselves," believing that they could now respond quickly to the loss.

"We'll never be forgiven for our sins on this," Obenschain says. "GOES is a classic study of how not to run a program." But what is the penance for unforgiven sins? Does it mean that NASA, and in particular Goddard, will come under additional scrutiny? Will other programs suffer?

"No," Obenschain replies. "We've already been reviewed and re-reviewed ad nauseam. Careers won't be tainted. And Congress isn't going to stop funding geosynchronous weather satellites. They're necessary. But whenever anybody talks about GOES, it will never be just 'GOES.' It will be 'the over-budget, badly managed GOES.'" No matter how well the instruments perform, Obenschain says, that reputation will never be redeemed.

Program managers agree that NOAA and NASA learned their lessons about the potential damage of the pressure to launch. Perhaps. But after ground controllers lost communication in September with NOAA-13, the new polar orbiter launched last August 9, NOAA asked NASA to move up the launch of its replacement satellite.

SCOTT BRIGHTON

Two views of Hurricane Andrew indicate the improved resolution expected from the GOES Next series.

John Brown, who oversees final tests on the instruments, is confident that now the satellite will perform.

Paris On My Mind

William H. Gregory, former editor, Aviation Week & Space Technology Magazine

It's been 25 years since I attended the Paris Airshow for the first time, but the memory is still vivid. I remember Paris as an impressionist's muted sky, with the hard-edged outlines of fighters against soft-focus clouds. The whine of jet engines was my background music, and I took in the whole scene from a sunny seat on the veranda of some aerospace company's chalet, enjoying a snifter of cognac. And then there was the Farnborough Airshow in England, with its opening Sunday garden party, by invitation only, in some dell out in the country.

But fond memories may be all that's keeping the airshows going. For all their burnished metal, blinking lights, and hair-raising flying, the great international airshows defy logic. At their core, they are driven by emotion. And as the defense business shrinks and commercial aviation sinks ever deeper, the airshows are gradually losing touch with reality.

Many manufacturers review the growing calendar of trade events and find that their losses outweigh their gains.

Industry is grousing, as it has perennially, that airshows are too expensive, too long, and too many. Many manufacturers review the growing calendar of trade events and find that their losses outweigh their gains, yet the companies are ambivalent: marketing people see an airshow as an opportunity, while chief executive officers (and government officials) see it as a source of pain and dismay.

Little is actually sold at airshows—and the boss knows it. Future customers may be tagged and released, but orders for big-ticket items like airplanes take months or years to develop. Business deals, clinched long in advance and then announced at the ritual press conferences as if the ink were still wet, are pseudo-news. Corporate bosses hate to stifle their marketers, but they fear the airshows are a bad use of valuable time and a boondoggle in full view of the stockholders.

Congress and the Pentagon suffer from the same kind of heartburn. Even though aerospace is approaching a historic low after 40 boom years, outsiders at Paris last summer could hardly believe how many lavish habits persisted. A major corporation can easily drop $2 million or more for an entertainment chalet on the flightline and a display in the exhibit hall. Take along an airplane to demonstrate and you can tack on up to $1 million. In 1993 Congress ruled that it be given 45 days' notice whenever the Department of Defense planned to play a direct, substantive role in an airshow. Last year deputy secretary of defense William J. Perry put out a memo forbidding direct Pentagon participation at Paris. Contractors could lease an airplane for the show, but spooked Pentagon lawyers said all leases had to be at fair market value. That eliminated any U.S. presence except for contractors who could wangle an American airplane from a foreign owner. Aerospace contractors are still sore, but they are beginning to respond to economic reality.

It's the airshow organizers who have been slower to see the light. The problem is that after years of growth, airshows took on a life of their own. Mark Sullivan, who oversees Pratt & Whitney's airshow efforts, keeps a list on his desk: Taiwan and Moscow were held in August and September of 1993. China followed in October, Dubai in November, and Malaysia in December. Then comes Singapore in February of '94, followed by South Africa in April and Britain's Farnborough in September. "We're going to all these in one form or another," he marvels.

Most big multinationals are questioning the wisdom of supporting such a schedule. Martin Marietta head Norm Augustine told me he took his company out of Paris last summer because with layoffs in the works, a junket to Paris was out. Hughes dropped out too, mostly because of the cost. Industrial spying—the reason that made the papers—was simply the last straw. (Let's face it: genteel espionage is what airshows are all about.)

The big industry shows also have regional identities that play on perceived trends in geo-marketing. Right now Asia is hot; Europe is not. Moscow's embryonic show, aided by U.S. government diplomatic support, is part of the same trend. And manufacturers who

While the aerospace industry shrinks, trade expositions are proliferating. Airshows must learn to adapt their traditions to the times.

want to sell to emerging Asian markets are pressured to attend those regions' shows.

Typical of the exhibitor dilemma is Allied Signal's Aerospace Group. Projecting its exhibit budgets to rise to almost $5 million a year in the 1990s, Allied decided to make a test case of the Paris show last summer. To wring $2 million out of Paris, the company consolidated its exhibit, cut the number of employees attending from 180 to below 60, and reduced the length of their stay.

If airshows are driven by emotions, not the least of those emotions is fear. Listening show after show to expressions of outrage about the price of Paris, I would ask, *Why go?* The answer: If we don't, the competition will rip us to pieces. Under today's scrutiny of benefits versus costs, airshow benefits are intangibles. For intangible, read expendable. But Allied will stick with Farnborough, and despite dismay over show proliferation, the company worked both Moscow and Dubai.

Over at the Department of Commerce they see things differently. To them, airshows are a hot venue for trade promotion. In Commerce's view, government, including the military, ought to promote American aerospace exports. Every year, Commerce runs a U.S. pavilion at Paris where small companies can hawk such small stuff as forgings, castings, and hoses; the companies pay far less than they would if they had to have their own stands. At Farnborough, Commerce hires a contractor to provide a common hall for U.S. companies. But Commerce has not yet come to terms with the emerging-market airshows.

One way to control costs is joint exhibits. Richard Milburn, who heads a U.S. Aerospace Industries Association committee against show proliferation, says that American companies have come close to sharing facilities several times. Joining with the commerce department for a large economy-size American exhibit is a possibility if money gets tighter.

Milburn spent part of his time at the Paris Airshow last summer trying to convince the French sponsors that 10 days is too long for the show. His efforts must have had some effect, because Paris will be two days shorter next time. And Farnborough's sponsors, who got the same pitch earlier this year, have cut the opening Sunday from the 1994 show. Next on the list is trimming hotel, food, and transport prices.

Proselytizing has begun for a four-year rotating cycle that would work like this: Europe would have Paris one year, Berlin the next, then Farnborough and Moscow in the third and fourth years. Asia would work similarly. Such talk is not received well by the Paris show, which needs fairly frequent revenue transfusions. And the organizers of Asian shows will ask why they should restrict their own growth.

Bully for the British, who are asking what exhibitors want and seem willing to wrestle with hotel and travel prices. The U.S. commerce department's national pavilion is the right idea. Give companies a less expensive exhibit option and knock off the lavish entertainment. If the U.S. government wants to support aerospace exports, Congress and the administration should say so. Let the commerce department pay for U.S. airplanes in the skies over Paris, and get the defense department off the hook.

Conventions like the National Business Aircraft Association's are a model alternative. Put the exhibits into a big hall downtown and do business quicker and cheaper. Stunt flying at airshows has little value, so put the flying out at a nearby field where the prospective customer can kick the tires and see a full demonstration flight, not gawk at a few minutes of aerobatics.

Exhibitors don't want airshows to die—at least not yet. If organizers don't recognize that extravagance is dead, that soaking the customer is hazardous to airshow health, that not every airshow is a command performance, exhibitors will eventually turn off the switch. Meanwhile, they are sending a mixed message. They'll show up if they have to, but they will cut back hard on the costly froth.

Give companies a less expensive exhibit option and knock off the lavish entertainment.

One Hundred Minutes to Freedom

by David Savold

Sometime around 4 a.m. on December 19, 1992, the manager of the Seaward Motel on Florida's Marathon Key heard the bell ring at the front desk. In the lobby he found two men waiting to check in. The younger of the two was wearing shorts and a short-sleeve shirt. The other, who appeared Hispanic, was wearing a dark blue running suit and moved like an athlete. He had what could be described as a baby face, but this morning his eyes were bloodshot and had dark circles beneath them. The name he signed in the hotel register was Joao Garcia.

The manager probably wouldn't have been surprised to learn that Garcia wasn't the man's name. This was southern Florida, where drug smuggling, much of it done by air, was a fact of life. Marathon Airport, a small facility that handles mostly Piper Cubs and a handful of corporate jets, was just across Route 1 from the motel. In fact, the two men had just landed there in a twin-engine Cessna 310.

But the man who was calling himself Garcia was no drug smuggler. He was Orestes Lorenzo Pérez, a former pilot in the Cuban air force who had made headlines the previous year when he defected to the United States by flying a MiG-23 to Florida. Though he had gained his freedom, Lorenzo purchased it at the cost of his family, whom he had been forced to leave behind. Now he was planning a defection in reverse: a flight back to Cuba to bring his wife, Victoria, and their two sons—Reyniel, 11, and Alejandro, six—to the United States.

Lorenzo's companion was Ron Murphy, the Cessna's previous owner. He had flown down with Lorenzo from Columbus, Georgia, mainly to provide a voice for the radio, just in case anyone monitoring the airwaves from Cuba should recognize Lorenzo's voice. Tomorrow Lorenzo would set out alone for Cuba.

Cuba was still their home when Orestes and Victoria posed for a photograph atop Havana's sea wall in the mid-1970s.

Last year Cuban defector Orestes Lorenzo Pérez flew an aged Cessna back to his homeland. His visit was extremely brief—and quite to the point.

Thirty years after Fidel Castro's revolution, the Pearl of the Antilles had long lost its luster. Its economy already hard-pressed from a U.S.-imposed trade embargo, Cuba had recently lost the vital economic support of the Soviet Union, its major trading partner. As the economy worsened, fuel and food became scarce. So desperate were living conditions that in 1992 thousands of Cubans would risk crossing the Florida Straits in barely seaworthy vessels to escape.

KRISTINA ARRIAGA

When the Cuban government refused to release his family, Lorenzo embarked on a series of public events—from posting billboards in the U.S. to chaining himself to a fence in Spain—to rally support for his cause.

MARIA PAZ MARTINEZ NIETO

Lorenzo had been born in 1956, two years before Castro's guerrilla forces overthrew the Batista regime in Cuba. When Lorenzo was three, he flew his first airplane—a toy his Uncle Orlando had brought for Christmas from the United States. It would inspire Lorenzo's dream of flying and eventually lead him to be chosen for a scholarship to flight school in the Soviet Union. There he learned to fly a small Czechoslovakian Aero L-29 Delfin two-seat jet trainer. Soon he was flying MiG-21s in Angola, part of the Cuban forces sent to support the country's Marxist government against the guerrilla armies attempting to overthrow it.

Lorenzo and Victoria married in 1976. While Lorenzo's military career forced him to endure long separations from his wife, Victoria studied to become a dentist. Their first son, Reyniel, was born in 1981. Four years later the family was sent to the Soviet Union so Lorenzo could attend officer training school. When they finally returned to Cuba, Lorenzo was assigned to Santa Clara Air Base, about 165 miles east of Havana. There he found that the only changes in Cuba had been for the worse. Even compared to life in the Soviet Union, which was undergoing the thaw of Gorbachev's *glasnost,* Cuba was unbearably oppressive. Castro, trying to distract the citizens from their internal problems, now kept the country on alert for a U.S. invasion. "I used to sleep three or four days inside the base because tomorrow will be American invasion," Lorenzo remembers. "Psychologically, it's terrible."

Now deputy base commander, Lorenzo talked with his wife for months about what to do. Finally they both realized he must go. "We decided that the best way to do it, I would fly away. I would try getting out of Cuba," he says. On March 20, 1991, Lorenzo suddenly appeared in the Florida skies over Boca Chica Naval Air Station in a MiG-23, circling three times in the noon sun and waggling his wings to signify friendly intentions.

The Cuban government publicly promised that any Cuban with a visa would be allowed to leave the country, and Lorenzo had hoped the government would want to avoid creating a scandal by keeping his family. Yet he told Victoria on the day he left, "If in a year you are not allowed to leave Cuba, I will be back for you. I don't know how—in a boat, a plane, or swimming—but I will be back for you and the children."

Soon after his arrival in the United States, Lorenzo started a campaign to win his family back. Radio Marti carried his appeals across the Florida Straits to Cuba. In New York City, he denounced the government of his former country

COURTESY ORESTES LORENZO PEREZ

at an anti-Castro rally. In Geneva, he asked for the world's help before a United Nations Human Rights Commission. In Madrid, he chained himself to the gates of Retiro Park and went on a week-long hunger strike. He met with a host of dignitaries, including President George Bush, Mikhail and Raisa Gorbachev, and Coretta Scott King. But it was all to no avail, and Lorenzo began to feel increasingly helpless. "Every night my children were calling me," he says. "In fact, I used to sleep a couple of hours and I'd get up scared because I could confirm that my children were with me in my room. They were talking to me. They were asking for help."

The Cuban government had told Victoria that the family would never be allowed to leave the country, and Lorenzo realized he would somehow have to get them himself. Helicopters and speedboats were out—both were too expensive. The only way he could get to Cuba and back again was with a light airplane. So Lorenzo started taking flying lessons. Although he had flown over a thousand hours in high-performance jet aircraft, he had never flown piston-engine or light airplanes. He enrolled in a flight school near his new home in northern Virginia, and for six weeks the ex-MiG pilot attended classes with a dozen neophyte aviators as fellow students.

As soon as he got his license, Lorenzo started to look for an airplane. Through friends at the Valladares Foundation, a human rights organization founded in 1989 by a former Cuban political prisoner, he learned of a 1961 Cessna 310F with 6,000 hours on it. Painted white with a blue racing stripe and a nose the same turquoise as the water off the Florida Keys, the twin-engine airplane had been manufactured the same year as the Bay of Pigs invasion and it looked its age. Originally owned by the state of Georgia, it had spent some time in New Mexico before Ron Murphy had purchased it in November 1991. He was willing to sell it for $30,000, and the Valladares Foundation agreed to purchase the airplane for the rescue attempt.

When he checked into the Seaward Motel, Lorenzo had not slept for three days, yet once in his room he resumed studying the plans for his flight. Every night for the past several months he had been working things out in his tiny one-bedroom apartment in the Washington D.C. suburbs. He had covered his map, a chart of Cuba's western coast he had purchased at a store only two blocks from the White House, with equations and sunset times. He hoped his inside knowledge of Cuban air defenses would help him slip through the system.

After public rallies and meetings with luminaries like Coretta Scott King and Mikhail Gorbachev failed to free the family, Lorenzo realized a rescue attempt was inevitable.

ANA COLON BRUBAKER/COURTESY ELENA AMOS

KRISTINA ARRIAGA

Taxiing out on the runway, Lorenzo prepares to begin his flight to Cuba. It would also be his first solo in the Cessna.

KRISTINA ARRIAGA

JOHN RICKSEN

The next morning he walked back to the airport to check his Cessna. He refueled the two wingtip tanks for what he hoped would be a 200-mile round trip. Several hours before he had arrived in Marathon Key he had talked to his wife and, in a carefully planned code, told her when he would be arriving. He would start his flight around sunset, arrive with the last rays of the sun, and get out under a descending curtain of darkness. He needed just enough light to land on a highway, and then darkness to protect him from any Cuban MiGs that might pursue him. To arrive at the rendezvous site in Cuba at 5:45, Lorenzo calculated that he would need to take off at 5:07 exactly.

Later that morning two friends from the Valladares Foundation met him at the airport. They wanted to take pictures of Lorenzo with his Cessna and he good-naturedly complied, although he was nervous about creating a scene. Well aware of the prevalence of drug smuggling in the Florida Keys, he didn't want to arouse suspicion by hanging around the airport. He and his friends went for a walk. They had lunch at Pizza Hut. They got ice cream cones.

At 4:00 p.m. Lorenzo returned to the airplane, did a final walk-around check, and then climbed into the cockpit. He was still wearing the running suit, an early Christmas present from friends who had asked him to wear it on the flight. He sat in the cabin repeating everything until 4:50. Then he started the engine. After one more run-through of his checklist, he started to taxi slowly to the runway. At exactly 5:07 he radioed local air traffic: "Cessna 5819. Departing runway 07."

Lorenzo left the Keys, flying about a thousand feet above the flat and translucent sea. Far off he could see a tanker crossing the Florida Straits. Ninety miles away lay Cuba.

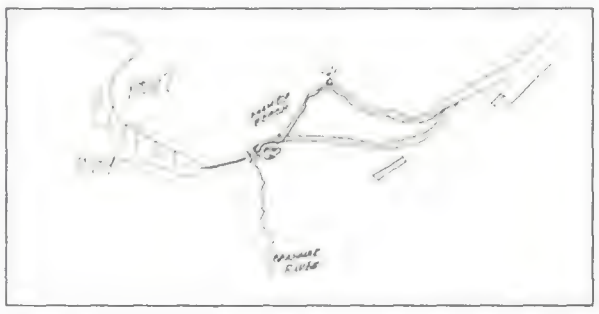
On his left knee Lorenzo had his flight plan. On his right knee he had strapped his calculator. He had also brought a camera, but nothing else except for some soft drinks and a box of chocolates. To protect himself in the event he was caught, he had left all identification cards at home.

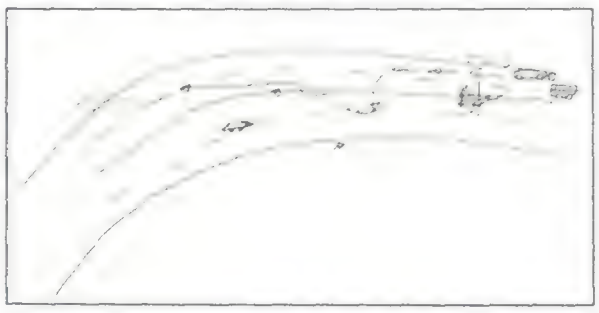
As he got further out over the Gulf Stream and the sea turned darker blue, he shut down the radar transponder, lights, and radio to avoid being detected. After he had been flying for about 15 minutes, Lorenzo started to descend until he was flying about ten feet above the waves. His altimeter indicated zero. He had a loran system to navigate and determine his geographical position. As he approached the 24th parallel, which lies almost halfway between Key West and Cuba, he realized that he was ahead of schedule. At Marathon he had gotten figures for wind velocity and direction, but the tailwinds were a little stronger than expected. Lorenzo considered making a 360-degree turn to kill time, but decided against it in case he was already on Cuban radar.

Lorenzo calculated that once he appeared on Cuban radar, he would have about 15 minutes to pick up his family. He knew it took 20 seconds for the radar to complete a 360-degree sweep. Even

if the radar operator were paying close attention, Lorenzo knew the radar would have to sweep the screen three times before the operator could positively identify Lorenzo's Cessna as an aircraft flying south. But Cuba's P-14 radar didn't provide altitude information: to get that, the operator would have to call a PRV-11 radar operator. This would give Lorenzo at least another minute.

The key to Lorenzo's plan was the clumsy chain of command that would be initiated at this point. An alert would require a time-consuming series of phone calls up the command hierarchy, from a company to a battalion to a brigade to a division. That would buy him a few more minutes as he got closer to his destination.





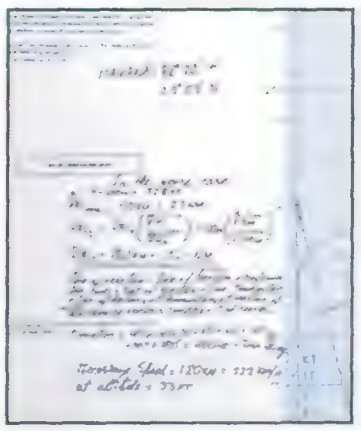
He had other advantages. He knew that the island has daily blackouts to save power, so the radar is often shut down. The system's old Russian radar uses tubes instead of transistors, and Cuba's humidity causes them to break down often. He also knew that the people operating the radar were increasingly apathetic. "The situation in Cuba is nobody cares for anything," he says.

In fact, Lorenzo was less concerned that the Cuban air defense system would catch him than he was that his wife and children wouldn't make it to the rendezvous point. Victoria would have a difficult trip. When Lorenzo was checking into the Seaward Motel earlier that morning, his wife had been getting up at her parents' house in Havana, where she had moved with her sons after Lorenzo's defection. To reach the rendezvous spot, she had to travel 70 miles through a country where gasoline was so scarce that Castro had declared 1991 the Year of the Bicycle. She left at 8 a.m. and, like many around Cuba, caught rides with passing cars. For each ride she paid a hundred pesos—in a country where an engineer made only three times that in a month.

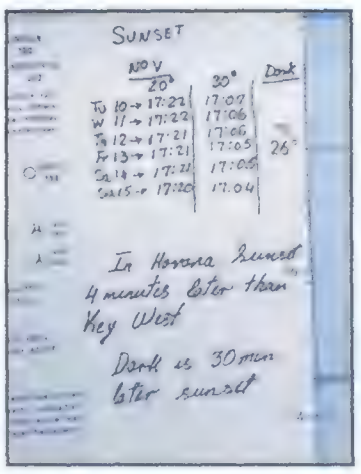
Lorenzo would have liked to pick up his family on a highway where he used to land his MiG-21 during military exercises. But the rendezvous would have to take place at a spot that was both accessible to his wife and yet not likely to arouse the suspicion of anyone keeping her under surveillance. This meant the rescue site had to be somewhere between Havana and Matanzas, where his parents lived.

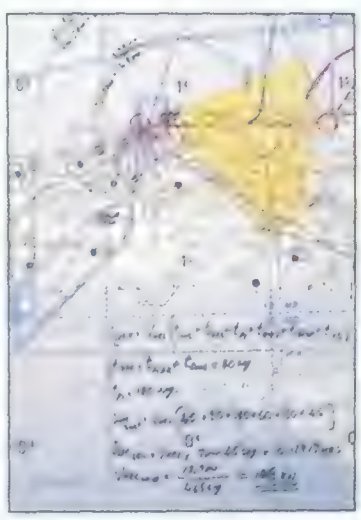
He knew the Matanzas area well because he used to snorkel nearby. For the rendezvous point, Lorenzo had picked a new highway that ran from the old coastal highway to a new airport. The only problem was that the site was located near four anti-aircraft missile complexes. But Lorenzo knew that authorities would need Castro's personal okay before shooting down an airplane. Even after Castro had been located and had given the command, it would still take a minimum of three minutes to warm up the radar—if it had been shut off during a blackout. Lorenzo also knew that the missiles' range was only 15 miles. He hoped that by the time the missiles were ready to fire, he would be well on his way back to Florida.

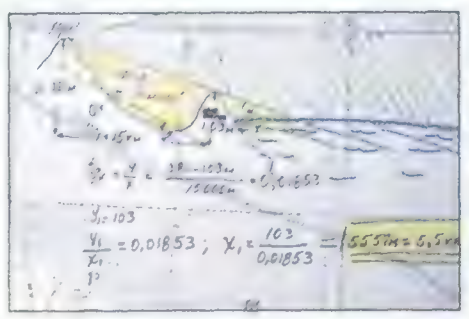
Not long past the 24th parallel, Lorenzo saw Matanzas materialize on the horizon. First he saw the hills that loom over the city, then the buildings and the 400-foot-high bridge that spans the Canimar River. As he approached the bridge he began to climb. His wife was supposed to be waiting about a mile east of the bridge, where the road curves



JOHN RICKSEN (4)







Lorenzo prepared his flight carefully (top). His sketches show how he approached the Cuban coast and the city of Matanzas, then landed on a highway (left).

Fifteen minutes away from Cuba, Lorenzo felt secure enough to take a picture of his family (right). Victoria returned the favor by taking his (below).

MARIA VICTORIA ROJAS

ORESTES LORENZO PEREZ

around a hill. Lorenzo was flying so low, however, that the hill blocked his view of the rendezvous site. He banked around the hill at about 20 feet and finally spotted the rendezvous spot. But he still didn't see Victoria. He had only a single chance to land, so he reduced speed and dropped the landing gear.

He was approaching to land on the two-lane highway when he saw his wife on his left. As he had instructed, she and the children were wearing brightly colored clothes so he could spot them quickly. It had been 21 months since he had last seen them, and now there they were on the side of a road, wearing fluorescent orange T-shirts and caps.

Below him, a small car was moving in the same direction as the airplane. Several hundred yards ahead of it a truck was approaching. Behind that a bus was trying to pass.

GARY PERRIN

Lorenzo had planned to fly to Miami, but in the end opted to land at Marathon. His return was a cause for celebration.

COURTESY ORESTES LORENZO PEREZ

Lorenzo planned to fly over the car and land in the highway between the car and the oncoming truck when he noticed a large rock in the middle of the road.

He didn't have room for a proper landing, but he knew there wasn't time for a second approach. He overflew the car and raised the left wing to pass the rock, then touched down. When the Cessna came to a stop, Lorenzo found himself staring directly at the truck's driver, who sat clutching his steering wheel, his eyes wide and mouth open.

KRISTINA ARRIAGA

Victoria didn't see her husband until the airplane was almost on the ground. She and the children had their backs turned to the Cessna as it approached and couldn't hear it because of the traffic on the highway. Now they ran toward the airplane, Victoria gripping her sons' hands.

While his family was running to him, Lorenzo turned the Cessna around and then made another 90-degree turn to the left to keep the propellers away from his family. He opened the door on the starboard side and they scrambled up into the cockpit: Reyniel, Alejandro, and finally his wife. Alejandro was barefoot because he had lost both his shoes while running. "Papi! Papi!" the children cried as they tried to hug their father. But Lorenzo had to concentrate, and he sternly ordered them to be quiet and

sit in the seats behind him.

His family now aboard, Lorenzo hurried to close the door. Twice he tried, and each time he failed. "*Cálmate, cálmate*," his wife said. "Calm down, calm down." On the third try he got the door closed.

KRISTINA ARRIAGA

With the airplane's flaps set for a short field takeoff, Lorenzo began to accelerate down the highway. As the airspeed indicator showed 60 mph—not fast enough to take off—Lorenzo could see the highway's curve approaching. He pulled the yoke back slowly and the airplane continued accelerating, gaining speed.

Finally the Cessna cleared the ground. *We did it!,* Lorenzo thought, and he retracted the landing gear. In the back seat, Victoria wrapped her arms around the boys. They recited the Lord's Prayer.

As he left Cuba, Lorenzo flew over the sea as low as he could. "I had experience flying at low altitude for the war in Angola," he says. By flying over the water at night at low altitude and low speed, he hoped to be an elusive target for any pursuing MiG, which would have to spot him from above, using radar information from the ground that would be at least three minutes old by the time the pilots got it. Soon it became too dark for Lorenzo to continue hugging the water safely. He climbed to 200 feet and maintained that altitude until he reached the 24th parallel. There he climbed to 3,000 feet and turned the transponder and lights back on. Victoria and Lorenzo took some pictures with the camera, and Lorenzo remembered to give his children the box of chocolates he had brought. It was dark. No moon or stars were shining, but soon Lorenzo saw the lights of the Keys and U.S. 1 with the lights of cars extending north to *el monstruo,* as his kids had been taught to call the country that was about to become their new home. "*Mira, mira*," he urged his wife as he pointed to the lights. "Look ahead, look ahead."

He called air traffic control and they assigned him an altitude of 7,000 feet. Originally he had planned to fly to Opa Locka Airport near Miami, but now he was spent, physically and emotionally, and ready to land. "I was so excited," he says. "I wanted to embrace them, you know. I don't want to fly. They were free. We did it. We wanted to enjoy. I was suffering because I couldn't embrace them."

At 6:45 p.m. he was back on the ground. From start to finish the rescue flight had taken less than 100 minutes. The Cessna was covered with salt.

AGUSTIN BLANCO

At the airport, Victoria spoke with some of her husband's supporters on the phone. The daring rescue would soon turn the family into international celebrities.

AP WIDE WORLD

COMBAT COMICS

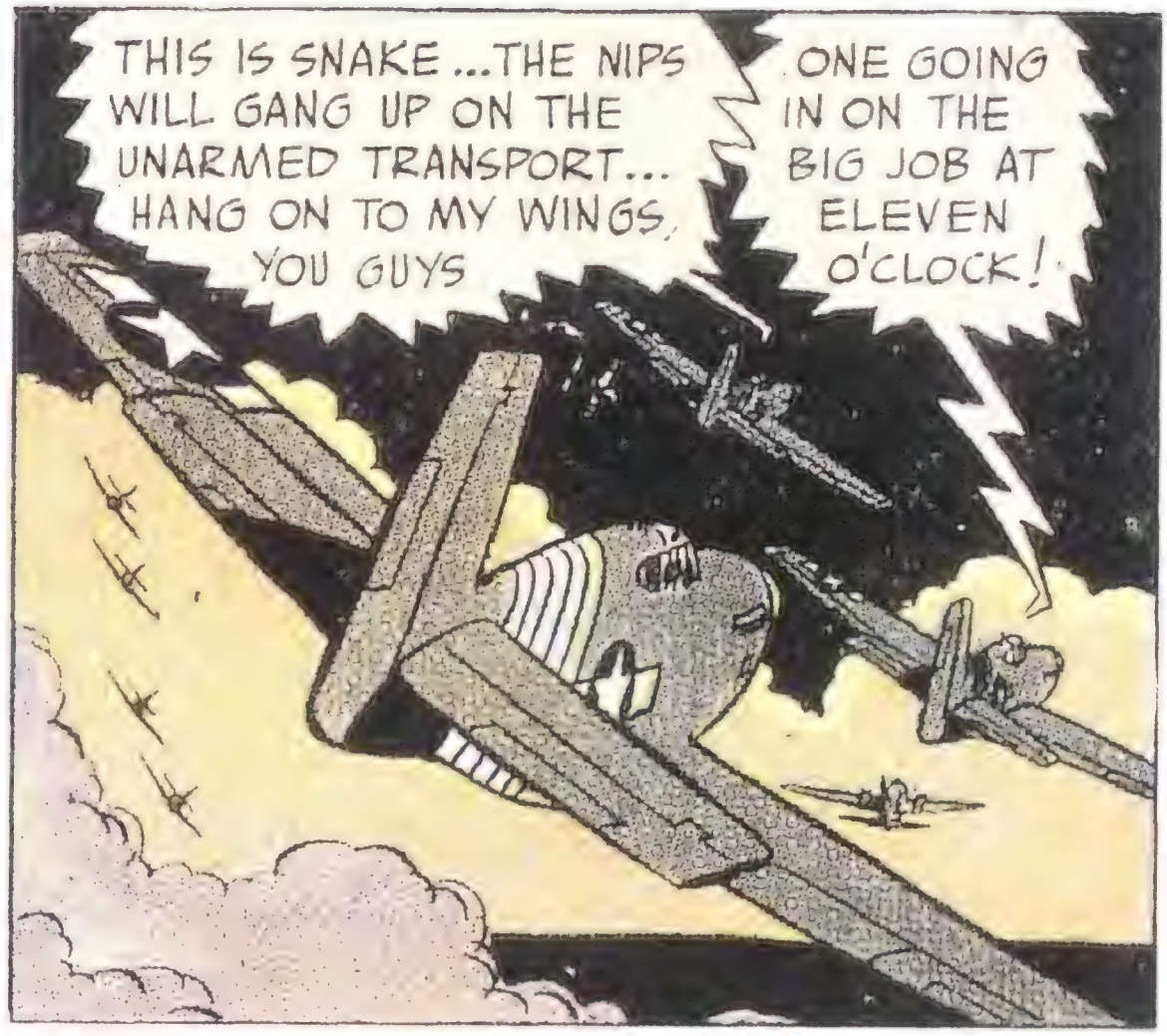
The funny pages kept a whole generation of kids informed—and occasionally misinformed—about World War II.

by Hal Higdon

Most people vividly remember where they were and what they were doing when they heard about the Big Events—the moon landing, the Kennedy assassination, the Sputnik launch. I distinctly remember the moment I learned that the Japanese had bombed Pearl Harbor: I was cleaning the storeroom where I kept my collection of comics.

I was 10 years old on December 7, 1941, and I had only begun to hoard comic books and clip strips I enjoyed. Over the ensuing years, I, like many other kids, experienced World War II mainly through comic strips. And the comic strips I loved most were the ones that featured airplanes.

In the 1940s air combat figured prominently in a number of comics. Frank Robbins sketched Johnny Hazard landing a B-25 on a German airfield to rescue a beautiful blonde. Roy Crane's Buz Sawyer piloted a carrier-based FM-2 to stalk Japanese submarines. Frank Miller drew Barney Baxter enthusiastically bombing Tokyo. And Zack Mosley—a founder of the Civil Air Patrol and one of the few cartoonists who actually flew—chronicled Smilin' Jack flying state-of-the-art warplanes while his sidekick, Downwind, chased pretty girls.



In those years, I studied cartooning on Saturday mornings at the Chicago Academy of Fine Arts, and after class, my fellow students and I would drop in on some of the popular comic artists of the day. Often we asked for original drawings, and the cartoonists would wave to a stack and say, "Sure, kids. Grab one on the way out." A framed Buck Rogers hangs by my desk today.

I sent other artists letters containing similar pleas. One day a small mailing tube arrived addressed to me. I couldn't believe it when I saw the sender's name. Carefully, I removed the rolled strip within: an original daily inscribed " 'Terry and the Pirates' for Hal Higdon, with my very best wishes—Milton Caniff."

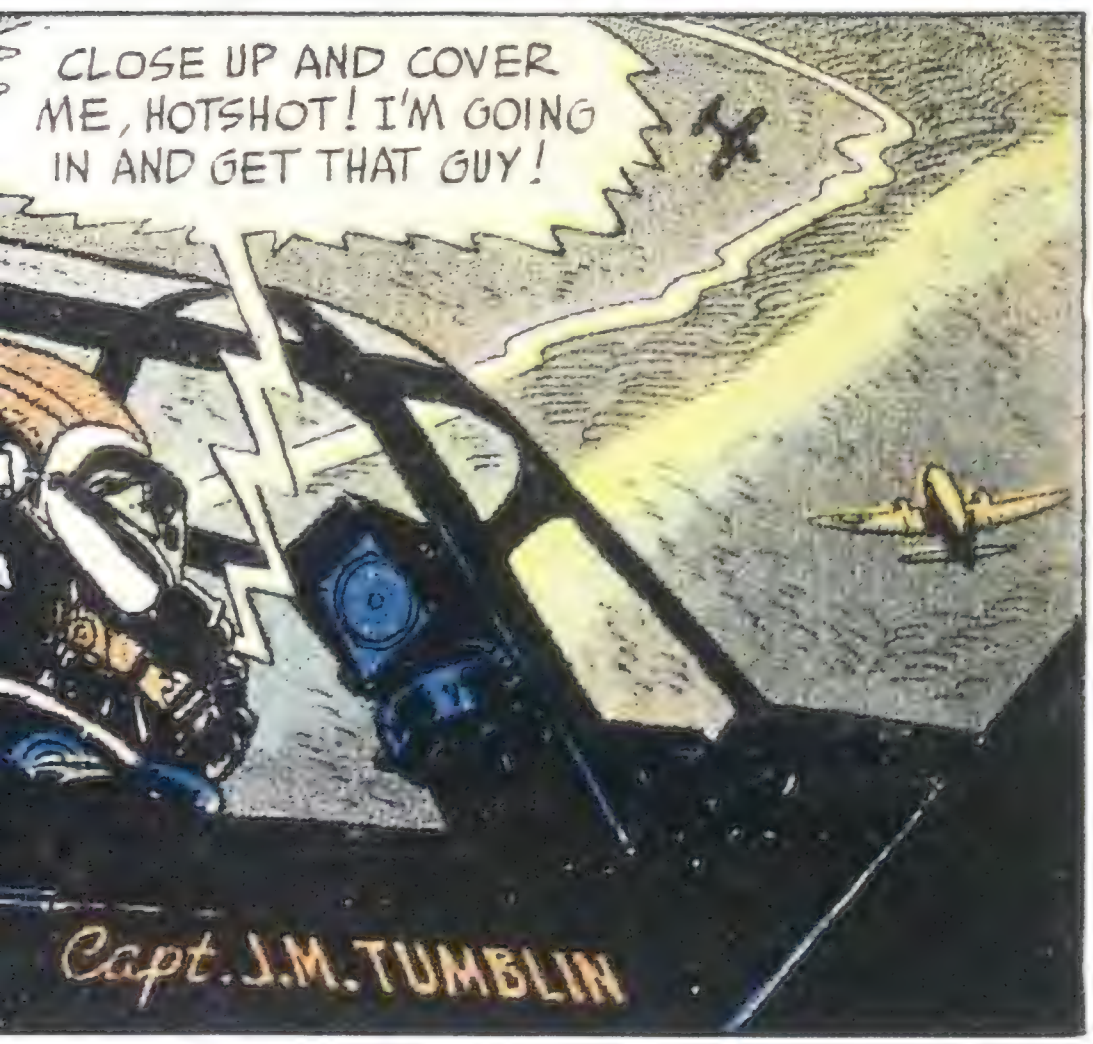
I was stunned. In my estimation, Terry and the Pirates was the best wartime comic strip of all.

How I loved Terry! He was a boy barely older than me, but Caniff aged him during the war and eventually made him a pilot. Oh, to be up in the air over China with Terry in a P-51 with its bubble canopy, clipped wings, and bulging airscoop. The Mustang was my favorite airplane and Caniff my favorite portrayer of it.

Alarming caricatures that depicted the enemy as exceedingly vile were a mainstay of Zack Mosley's Smilin' Jack.

In contrast to the cartoonists whose scratchy work surrounded his on the comic pages, Caniff was a master of shading, rendering light and dark in subtle chiaroscuro. His drawings of the equipment of war were precise. His plots flowed. He displayed a pixieish sense of humor that shamed artists like Robbins and Crane, who might come close to matching his accuracy of line but not his touch portraying people. Caniff's characters seemed real, but then he patterned many of them after friends in the military.

Of all the comic artists working in those years, it was Milt Caniff who maintained the most useful relationship with the War Department, both while drawing Terry during World War II and while working on his next strip, Steve Canyon. He was a careful researcher, often traveling to air bases to sketch airplanes and speak with pilots. On one such visit in 1944, he spotted an odd-looking machine with a propeller above rather than in front. Caniff included the machine in one of Terry's Sunday



Milt Caniff's Terry and the Pirates stood out from other wartime strips in using dramatic shifts in perspective, as in this hair-raising encounter between P-51s, Zeros, and a C-46.

BARNEY BAXTER

IN THE AIR

BY FRANK MILLER

REG U.S. PAT OFFICE

AT BREATH-TAKING SPEED, BARNEY'S DEVIL CAT BOMBER STREAKS LOW OVER THE OUTER DEFENSES OF TOKYO HARBOR!

LOOK, GUS! TH' JAPS ARE SO STARTLED THEY CAN'T EVEN SHOOT AT US!!

YEAH, BARNEY! BUT WAIT'LL THEY WAKE UP!

THEY'LL BLAST US WITH EVERYTHING THEY'VE GOT ····INCLUDIN' TH' **SCRAP IRON** WE SOLD 'EM!

GET SET, PAL! HERE'S AN AIRCRAFT FACTORY WITH A FLOCK OF "MITSUBISHI 97s" PARKED OUTSIDE! OH, BOY, WHAT A TARGET!!

BANG BANG!

WHAM!

BOOM

CRASH

AND HERE'S A STEEL MILL··· WIDE OPEN FOR ATTACK!

HOT ZIGGITY! IF THIS AIN'T PAYIN' OFF PEARL HARBOR, I'D LIKE TER KNOW WHAT IT IS!

BY NOW, THE JAPS ARE BRINGING THEIR LONG-PLANNED DEFENSE SYSTEM INTO ACTION! ANTI-AIRCRAFT GUNS BLAST FURIOUSLY····· WAR PLANES TAKE OFF FROM CARRIER DECKS····· ALL TOKYO IS IN PANIC!!

BOOM!

BOOM

BOOM

OH-OH! WE'RE GETTING INTO A HORNET'S NEST! HANG ON, GUS···WE'VE GOT TO GET SOME ALTITUDE!

MAKE IT SNAPPY! I SEE SOME FIGHTERS TO TH' STARBOARD SIDE!

LET 'EM COME! TAKE **THAT**, YOU DOUBLE-CROSSING RATS! AND **THAT**··· AND THAT!!

BANG BANG!

4-19

GOSH! WE'RE OUTNUMBERED FIFTY-TO-ONE! IF WE HOPE TO ESCAPE, WE'LL HAVE TO RUN FOR THE OPEN OCEAN AND CHEAT 'EM WITH SPEED!

TAKE IT EASY, BARNEY! HOW MANY BOMBS HAVE WE GOT?

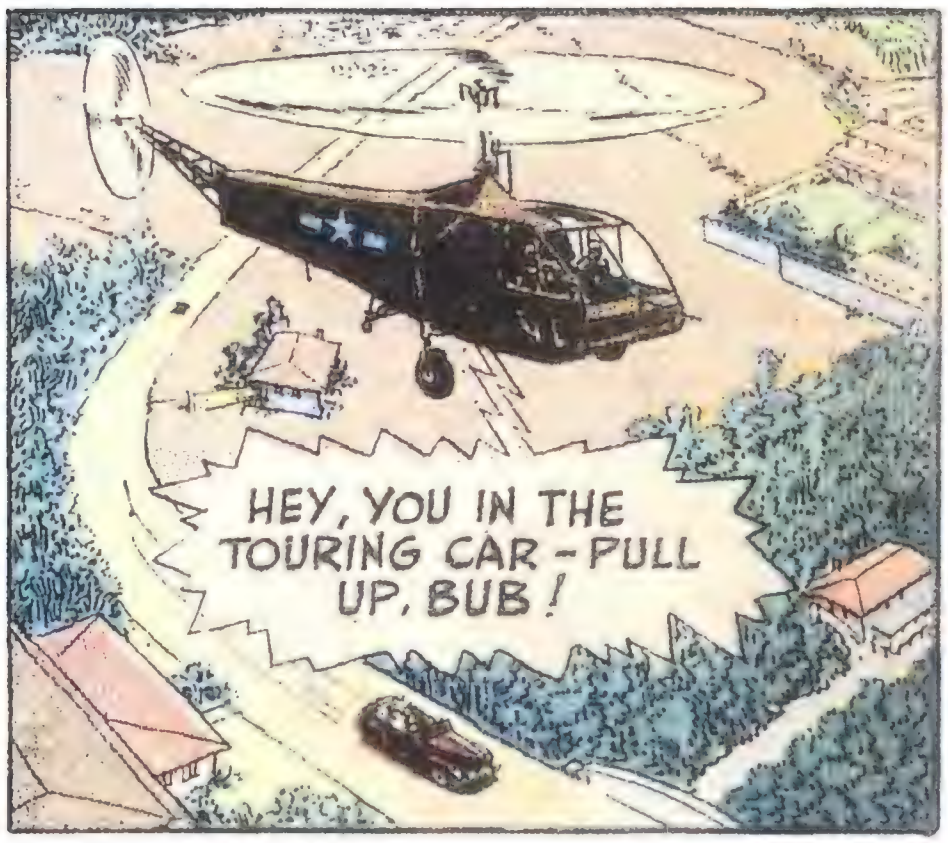
TWO!

OKAY! I SEEN A AIRCRAFT CARRIER AN' A BATTLESHIP AS WE CAME IN, AND···

SURE! WHY NOT?

FRANK MILLER

CONTINUED!!



When it came to drawing aircraft, many comic artists took some care to get the details right. Milt Caniff was probably the first to depict a new craft he initially thought was called a "heliocopter" (above). Zack Mosley's portrayal of a German Bf 109, though fairly loose, is still easily recognizable (below).

adventures, referring to it as a "heliocopter." One of my art school friends, Ed McGeean, owns the original drawing. McGeean later got to know Caniff and chided him about the misspelling. Caniff explained that everything about the craft was so hush-hush that nobody would admit even the spelling of its name.

Frank Miller didn't have the kind of military connections Caniff had, but one Sunday his Barney Baxter strip did seem to show a remarkable insight into American military strategy. Like most comic artists, Miller drew daily strips four weeks before publication, Sunday pages eight or more weeks ahead. When the United States entered the war in December 1941, Barney was in the middle of an Alaskan adventure, and it wasn't until mid-February that Miller could redirect his pilot hero's attention. Once he got Barney caught up in the war in the Pacific, the artist decided to have his freckle-faced hero stage a surprise attack on the Japanese in retaliation for Pearl Harbor. Barney bombed Tokyo in the comic pages on April 19, 1942—the same weekend that American bombs rained down on the real Tokyo.

If Jimmy Doolittle was aware that his mission had been duplicated in the funny pages, he made no mention of the coincidence in his autobiography. The government, however, probably frowned. At one point, federal officials thought Buck Rogers artist Rick Yager might be a spy. Even though Buck's adventures occurred in the 25th century, Yager drew his Martian enemies with slanted eyes and adorned their

Barney Baxter and goofy sidekick Gopher Gus let loose a barrage of bombs over Tokyo on the very weekend Jimmy Doolittle bombed the real city (left).

spaceships with a rising sun. One day Yager arrived at his studio and was told by a secretary to report to the local FBI office. "I sat down and the agent pointed to several spaceships I had drawn," Yager recalls. "I liked to give spaceships exotic names or numbers, like E55-457 or RK-22. The FBI worried that I might be sending information in code to our enemies."

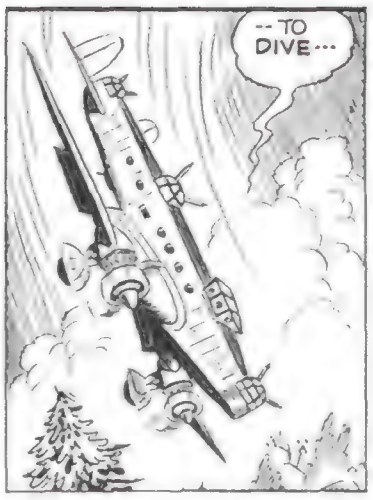
Like Yager, other comic artists freely mixed realistic touches with flights of fancy. Barney Baxter's "Devil Cat" fighter-bomber was wholly the creation of artist Frank Miller; it had no real-life counterpart. With its twin fuselages, it resembled a P-38 but featured a large bubble cockpit, which gave readers a better view of Barney in flight. Not all my art school buddies endorsed Miller's tampering with reality. Those who were fanatical about detail expected meticulously drawn airplanes coupled with perfectly accurate information about them.

Will Eisner—next to Milt Caniff, my favorite artist—gave his daredevil pilots snub-nosed, twin-engine, double-tail Grumman-like fighters, even though the airplanes lacked the speed and maneuverability of a P-47 or P-51. He later told me, "It didn't matter to me whether or not the planes flew well as long as they looked good."

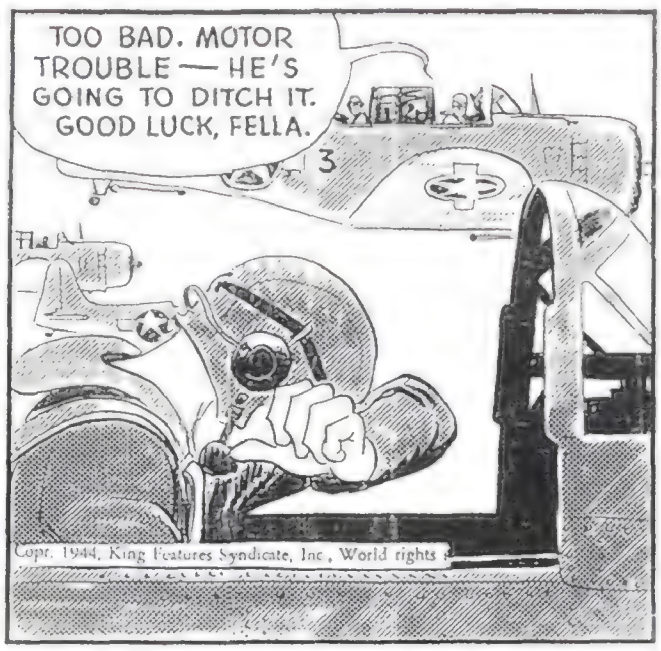
The warplanes in Zack Mosley's Smilin' Jack strip, though not terribly detailed, were generally accurate. But some of my friends sneered at Mosley's lack of perspective: in his depiction of a B-17 tail gunner firing at an attacking Zero, the airplanes look inches away. And the fang-toothed "Japs" Mosley portrayed as drooling in the cockpits seem ugly propaganda devices today.

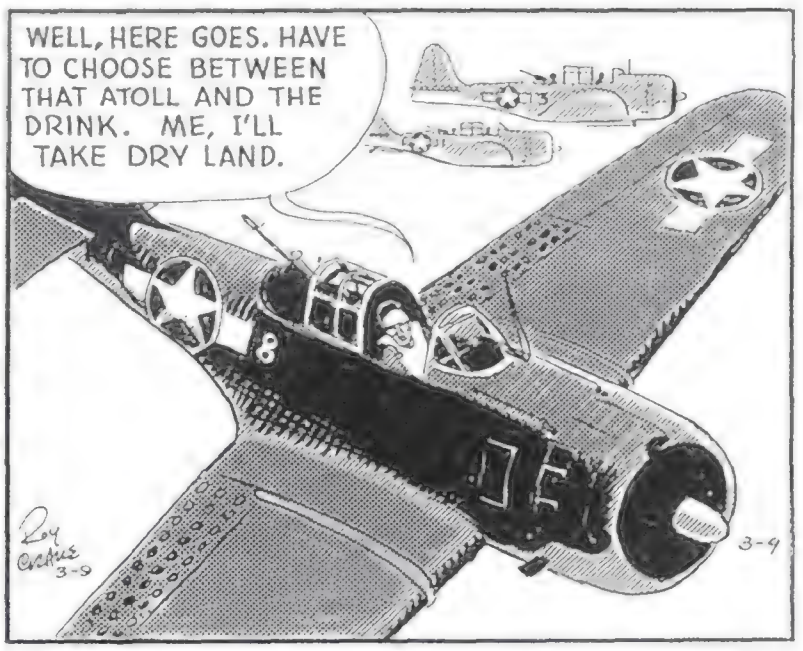
Milt Caniff, on the other hand, took care to render all aspects of flight, mechanical and human, as accurately as he could. In one strip, Terry takes flying lessons from "Flip Corkin," modeled after a real-life aviator named Philip Cochran. Caniff and Cochran became close friends when Caniff needed someone to provide precise information on pilot instruction. Cochran was commander of the 65th Flight Squadron in Groton, Connecticut, and early in the war Caniff visited the base there and interviewed Cochran and other pilots. Cochran also wrote Caniff a detailed 22-page letter explaining how Terry would learn to fly. According to the pilot, "He [Terry] must first learn that the controls are pressed, but easy like. Pressure, evenly applied, is the thing. No quick jerks or shoves will do. The idea is you fly an airplane with your mind, not your muscles—flying is an art, not a physical demonstration. The most difficult maneuvers...are performed without moving the stick more than one inch in any direction." Cochran's quote about flying being an art appeared almost verbatim in one of Flip Corkin's lessons.

Caniff was so meticulous in matching reality that Terry's training lasted as long on the comic pages (with time off for side adventures featuring other characters) as it normally took an air cadet to get his wings—eight months. Terry graduated on October 17, 1943; the day's installment, which featured Corkin giving Terry a final pep talk, became one of Caniff's most reprinted strips. "Okay, sport, end of speech," Corkin tells Terry. "When you get up in that 'Wild Blue Yonder' the song talks about—remember, there are a lot of good guys missing from mess tables in the South Pacific, Alaska, Africa, Britain, Asia and back home who are sorta counting on you to take it from here!"

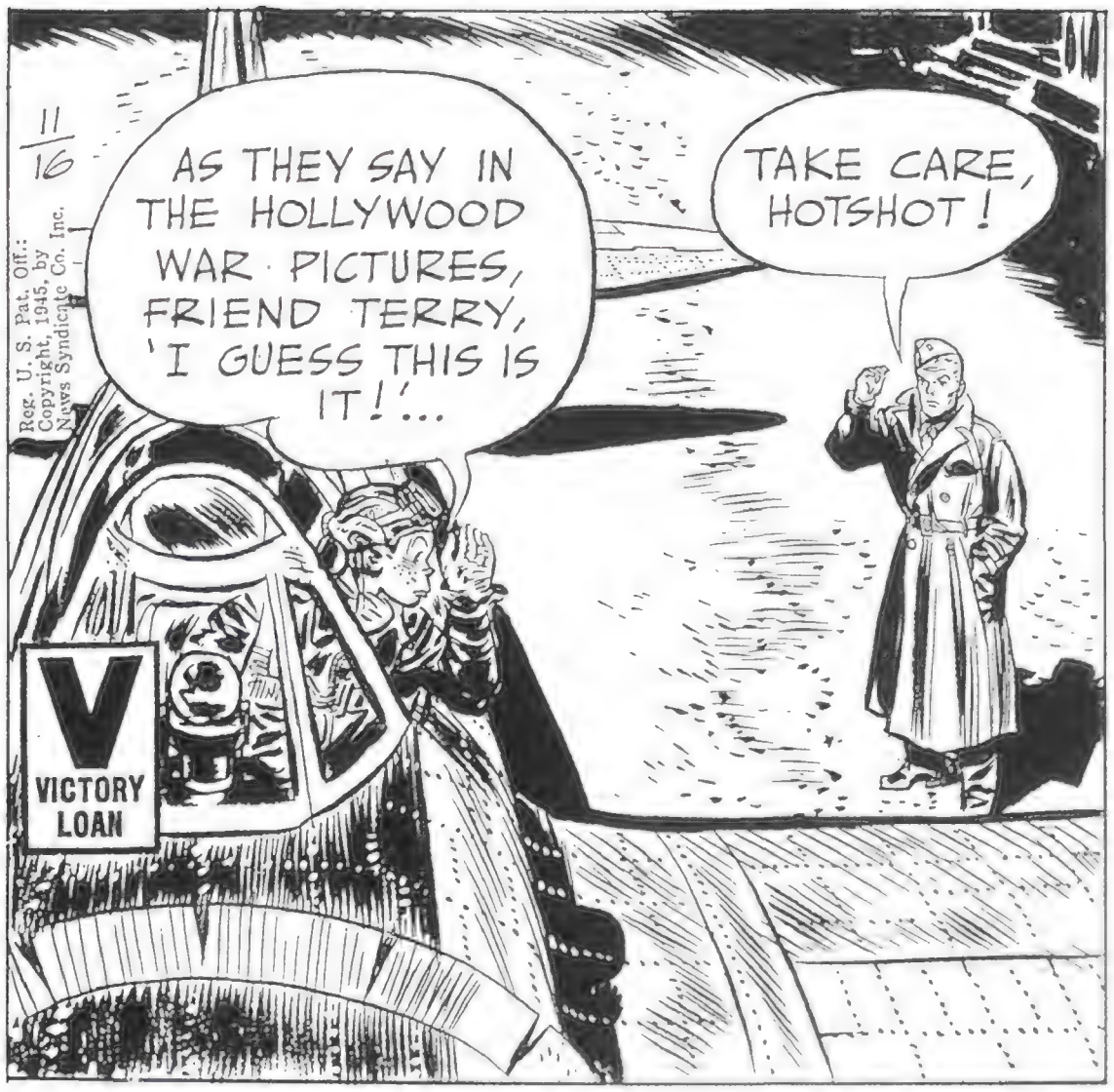


Though Zack Mosley usually depicted real aircraft, he made an exception with the Lady Halitosis, *which Smilin' Jack cobbled together from the parts of other airplanes when his own craft was out of commission.*





Comic pilots were largely an unflappable lot. Buz Sawyer and tail gunner Rosco Sweeney weren't much rattled by the sight of fellow SBD pilot Chili Harrison preparing to ditch over the Pacific.



I eventually met Caniff when he came to talk to a group of high school editors while promoting his new strip, Steve Canyon. Despite his success, he was modest about his accomplishments. Discussing the pilots he had used as models, he told us: "Each one has done something more spectacular by far than anything I had them do in the strip."

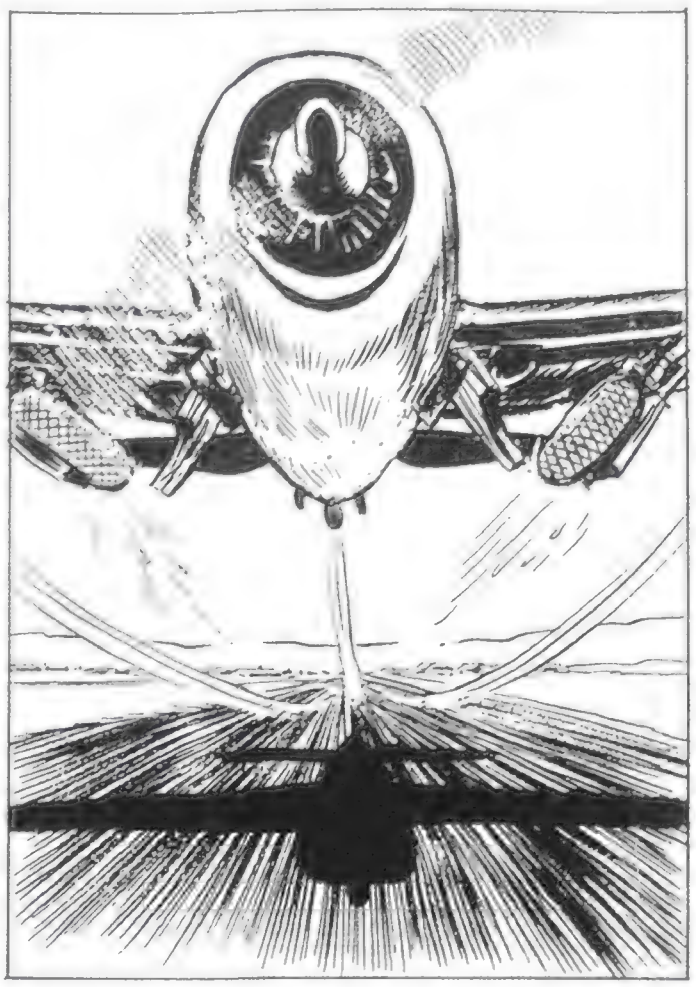
When the war ended in August 1945, Caniff's characters were on an obscure island off the Japanese mainland midway through an adventure that involved romance more than war. (Terry was trying to rescue pretty April Kane from a villain named Py-zon.) Caniff quickly redrew several episodes and allowed the war to wind down offstage.

Frank Robbins' solution to the war's end was to modify his strip so that Johnny Hazard continued to battle against Japanese soldiers who supposedly had not yet learned that their nation had surrendered. Meanwhile, Roy Crane, who at the time had Buz Sawyer in a task force steaming toward a major invasion of Japan, rushed a special strip into print two days after the Japanese surrender to explain his quandary, asking readers: "Can you bear with us while the episode runs its course?" For several weeks after the real war's conclusion, Buz's carrier had to repel kamikaze attacks. The adventure came to an end with a voice announcing over the ship's squawk box, "This is official! Japan has surrendered! The war is over!" Buz's response: an overhead balloon reading simply "!"

Nearly a decade passed before I entered the service. I did not join the Air Force; I lacked the 20/20 vision necessary for pilot training. Perhaps my mother's warnings had been right, and I had weakened my eyes poring over too many comics. I served ingloriously in Army ordnance. Stationed in Germany, I saw firsthand the work of the airplanes I had so admired in the funnies. I visited a palace in Würzburg whose ceiling paintings, beautiful works by the Italian master Tiepolo, had been badly damaged by Allied bombs. As a kid avidly following the adventures of Terry, Barney, and Buz, I'd never really thought that planes and pilots were not always friends of artists.

Discharged, I returned home to find that during my absence my mother had purged the basement storeroom where I had first heard about Pearl Harbor. Gone were comic books that if saved would make me wealthy today. Gone were scrapbooks filled with the art of Caniff, Crane, Robbins, and others. Fortunately, my mother hadn't touched the original drawings those cartoonists had sent me. I still have the Terry strip that Milton Caniff once autographed for a young artist. I now look at it fondly. It reminds me of the time when comic artists ruled the skies.

During the war, Milt Caniff's Terry chummed around with a brash little pilot called Hotshot Charlie (above; the "Victory Loan" logo was a common device for encouraging comic strip readers to buy war bonds). Shortly after taking off (right), Hotshot buzzed the airfield, infuriating the brass but secretly tickling Terry.



Securing the High Ground

JOHN F. KENNEDY LIBRARY

Space isn't just the final frontier.
It's the ultimate military advantage.

Adapted from the forthcoming book *Space: Exploration and Discovery*, to be published in September 1994 by Hugh Lauter Levin Associates, Inc.

by William E. Burrows

The notion of using space to protect and even extend American sovereignty—to guarantee "national security"—coincided with the lowering of the Iron Curtain after World War II. The flight of Sputnik 1 on October 4, 1957, further convinced the U.S. government that the arena of competition and possible conflict with the Soviet Union extended beyond the atmosphere. Sputnik seemed to be the latest manifestation of an "international Communist conspiracy" that spread red from East Berlin through the Eurasian landmass to the Formosa Strait. And now the enemy was adding a third dimension—the heavens. Senator Lyndon B. Johnson called space the "high ground" and saw its control in a clear historical context. "The Roman Empire controlled the world because it could build roads," the Texas Democrat grumbled. "Later, when it moved to sea, the British Empire was dominant because it had ships. In the air age we were powerful because we had airplanes. Now the Communists have established a foothold in outer space."

The "conquest" of space continued the ancient metaphor of height as a source of power. The Egyptians and Aztecs built pyramids into the sky to celebrate their worldly and spiritual prowess, as did those who labored, antlike, to construct the great cathedrals and temples at Chartres, Cologne, Angkor Wat, and elsewhere around the globe. Heaven was up. Kings, judges, popes, and priests dispensed law, justice, and salvation from elevated places. What leader could rule from a ditch? What nation could? A leap into space was the next step in the search for spiritual transcendence and political-military advantage. Be the eagle or be the eagle's prey.

Even before Sputnik, the three U.S. armed services started to actively plan ways to move into space. As early as 1952, the Bell Aircraft company approached the Air Force with Bomi, an idea put forward by Walter Dornberger, a Bell employee and former commander of the German V-2 team. Bomi, short for "bomber-missile," was to be a manned glider that could be launched by a two-stage rocket. It would then release its booster and coast to its target at an altitude of 100,000 feet and a speed of Mach 4. Over the next few years Bomi was studied and spun off into concepts for a reconnaissance system known as Brass Bell and a rocket-bomber called Robo. Both projects were eventually shelved, but not before creating spinoffs of their own.

One, the Manned Glide Rocket Research System, called for firing a piloted glider that would be boosted to an altitude of 70 miles on top of a conventional rocket booster at 21 times the speed of sound. In many ways, it would have worked much like the space shuttle. The Air Force also looked into a

U.S. AIR FORCE PHOTO/NATIONAL ARCHIVES

The military's contribution to the U.S. space program included booster development. At left, President Kennedy visits the Army's ballistic missile agency in Huntsville, Alabama, in 1962. For its part, the Air Force had plans for a craft called the Dyna-Soar, pictured here in model form.

In the early 1960s George Honzik illustrated lunar base studies for Lockheed. He drew lunar traversing vehicles that could transport habitation modules for astronauts (above). His lunar ballistic vehicles used rockets to travel around the moon (opposite).

Manned Ballistic Rocket Research System, which entailed putting a man inside a capsule that would be sent up on a military missile and then released on a ballistic trajectory. These ideas too were eventually abandoned.

But the vision of propelling armed airmen into the heavens would not fade. The launch of Sputnik and the consequent belief that a potential threat had suddenly turned into a real one refocused attention on a "warrior in space" program. Within months of the tiny satellite's successful orbit, the Air Force hatched an elaborate four-stage plan, designed by its Ballistic Missile Division, to seize and hold the high ground.

The first part of the plan had a name that reflected its designers' sense of urgency: MISS, for Man In Space Soonest. It called for flinging military astronauts into orbit by any means possible, beginning in October 1960. The first MISS was to be followed by another—Man In Space Sophisticated—in which a larger capsule would be used for flights lasting up to 14 days. The third stage was to involve a detailed survey of the moon's surface to select landing sites. The fourth and final stage, Manned Lunar Landing and Return, would require circumlunar flights by apes and then people, with a manned landing as a finale. All of this was to be accomplished by 1965 at a cost of $1.5 billion.

A moonbase had been the subject of a separate, low-key study before Sputnik, largely because such a facility would have a commanding military position over earth. After Sputnik, Army and Air Force space strategists quickly produced elaborate and highly competitive studies for the installation. The Army's comprehensive plan, which came out in 1959, was called Project Horizon. The Air Force produced several studies, many done in cooperation with the RAND Corporation, and all of them classified (several still are). Some of these were quite detailed. Lockheed Missiles & Space Company's George Honzik, a dazzlingly imaginative engineer, led a project that worked out detailed plans for prefabricated lunar shelters, a Lunar Traversing Vehicle that would use four large gear-shaped wheels to move over the moon's rough terrain, and round, skid-equipped Lunar Ballistic Vehicles that were to function like rocket helicopters.

One of the earliest public disclosures of the moonbase program occurred on January 28, 1958, when Air Force brigadier general Homer A. Boushey delivered a speech to the Aero Club of Washington, D.C., that sounded a clarion call for the arming of the heavens. Given President Eisenhower's abhorrence of any U.S. armed presence in space, whatever else could be said about the general's speech—and a great deal was—he at least showed that he valued personal conviction more than his career.

After describing planned outposts on the far side of the moon and the es-

tablishment of lunar observatories, Boushey concluded by explaining matter-of-factly: "The moon provides a retaliation base of unequaled advantage. If we had a base on the moon, the Soviets must launch an overwhelming nuclear attack toward the moon from Russia two to two-and-one-half days prior to attacking the continental U.S.—and such launchings could not escape detection—or Russia could attack the continental U.S. first, only and inevitably to receive, from the moon—some 48 hours later—sure and massive destruction."

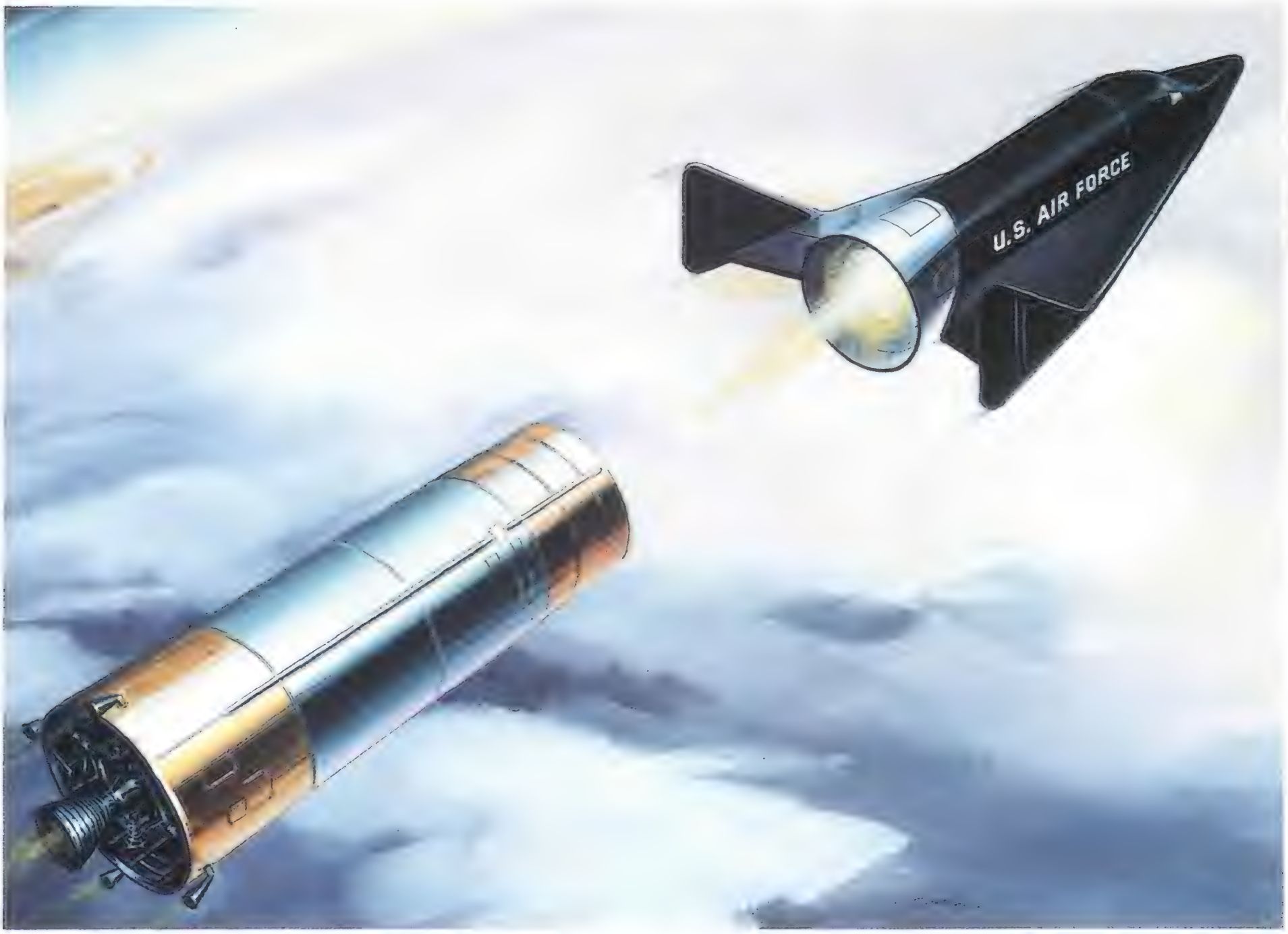
That, laid bare, was the ultimate military use of earth's sole natural satellite—a vantage point from which the whole planet could be attacked. *U.S. News & World Report* excerpted the speech under the headline "Who Controls the Moon Controls the Earth." Boushey's fortress in space was immediately ridiculed by some scientists and defended by a few generals. If Eisenhower had anything to say about the idea, it was not made public.

Within a couple of months of Boushey's speech, the Air Force requested proposals for a Lunar Observatory Study that would bear the hallmarks of the general's plan. In turn, that request led to three separate concepts for "projecting" Air Force operations into both near and deep space. They were to involve setting up an observatory on the lunar surface to reconnoiter the earth—turning the moon into a gigantic spy satellite—and creating a base and missile batteries with which to attack targets on the home planet. Serious consideration was even given to sending weapons systems to other planets, while scientists at Cal Tech's Jet Propulsion Laboratory briefly considered the idea of exploding an atomic bomb on the moon just to prove to the world that American power could reach that far. The broad outlines for the moonbase plan were duly passed on to *Aviation Week,* a leading and influential trade journal, which published them in April and September 1959.

Details of the moonbase, which were contained in a thick secret report called "Military Lunar Base Program or S.R. 183 Lunar Observatory Study," were revealed by the Air Force Ballistic Missile Division's Directorate of Space Planning and Analysis in April 1960. The heart of S.R. (Study Requirement) 183 was an underground Lunar Based Earth Bombardment System that would ensure "positive retaliation" in the event of a Soviet attack against the United States. Although the report said that construction of the missile complex could be postponed for three or four years, it called for active planning for the base to begin "*immediately* if maximum military advantage is to be derived from a lunar program."

S.R. 183 was emphatic about the base's military role, saying that it should be "a permanent installation, it should be underground, it should strive to be completely self-supporting, and it should provide suitable accommodations to support extended tours of duty." The report predicted that the bombardment system would have a "circular error

LOCKHEED MISSILES AND SPACE COMPANY ©



THE BOEING COMPANY

The Air Force's X-20 was better known as Dyna-Soar. The name proved apt when the program was pushed into extinction in 1963.

probable" of two to five nautical miles. This meant that atomic or hydrogen missiles fired from the moon would be able to strike their targets on earth within that distance.

These military plans were shelved when Eisenhower decided that the task of sending U.S. astronauts to the moon should be assigned to the National Aeronautics and Space Administration, a civilian agency created in 1958. The militarization of the moon, like the militarization of the Antarctic, was eventually outlawed by the United Nations.

A cadre of Air Force officers believed that civilian institutions like NASA were inherently incapable of meeting the Soviet challenge. They did not want to abandon the dream of sending officers beyond the earth's atmosphere. (The Air Force even invented the term "aerospace" to blur the line between air and space, in the process conveying the notion that it should be the dominating presence in both.) Thwarted in its plan to occupy the moon—which was probably for the best, given the staggering cost and technological complexity of such an undertaking—the Air Force lowered its sights to earth orbit, which it also hoped to control.

The two MISSs were soon replaced by three projects designed to carry airmen—"blue-suiters"—into orbit. Dyna-Soar (dynamic soaring), or the X-20, was a follow-up to Brass Bell and Robo. A small shuttle-type craft, it would be sent into space on top of a Titan III rocket and then glide back to earth. The ostensible idea was to use the diminutive delta-wing vehicle to evaluate the effects of space on the human body. Interestingly, it found more favor with Congress than with Air Force planners. This was because the latter wanted a reusable, winged space transporter, not a runt. In fact, Dyna-Soar proved to be a spacecraft without a portfolio and was canceled by Secretary of Defense Robert McNamara in 1963. The program's total cost, more than $400 million, almost equalled that of the entire Mercury program. It was succeeded by a plan to keep military personnel in permanent orbit aboard a small space station called the Manned Orbiting Laboratory (MOL). The third program, Blue Gemini, was a military version of NASA's Gemini spacecraft, designed to ferry crewmen to the MOL. When the MOL was canceled in 1969 for lack of an adequate mission, Blue Gemini went with it. The prospect of a manned military spacecraft ended, but plans to send military officers into space proceeded.

There were seven manned Apollo voyages to the moon, six of them involving landings, beginning with Apollo 11 in 1969 and ending with Apollo 17 in 1972. Eighteen of the 21 astronauts who participated in those missions were in the military. In addition, all of the Mercury and all but two of the Gemini astronauts who went into space before Apollo were military officers. Air Force

and Navy officers in space obviously pleased the Department of Defense.

Astronauts drawn from the military also suited NASA's purposes. James Webb, who led the space agency from 1961 to 1968—the key years for all three programs—was shrewd enough to value military participation for its political as well as technical value. Just as NASA centers and industrial contracts were spread across the country to widen the agency's political base, so were the military services, particularly the Air Force, drawn into its programs. Webb understood that if the Air Force and Navy were involved, they would be less likely to attack his fragile agency's huge engineering programs.

By the time Apollo 17 returned from the last moon mission, work on the next program, the space shuttle, was well under way. The shuttle was designed to provide regular access to space in the service of all national requirements, including military. The vast majority of shuttle astronauts would therefore also be drawn from the armed forces. Payloads would include Air Force (and Central Intelligence Agency) satellites, Strategic Defense Initiative experiments, and other dedicated Department of Defense work.

Despite the NASA emblem painted on their sides, the shuttles were largely military creatures. Although the Army and the Navy had their own activities in space, the Air Force acted as the Department of Defense's agent for space activities, including those involving the shuttle. The Air Force reluctantly agreed to allow the shuttle to carry all of its space payloads. In return, NASA incorporated military requirements into the shuttle design and gave military missions priority on its manifest. The shuttle's 60- by 15-foot payload bay, to take only one example, was sized to accommodate the KH-11 reconnaissance satellite. The civilian agency also had to accommodate the airmen in budgeting. While NASA absorbed almost all of the shuttle's horrendous development costs—and robbed several scientific and exploration programs in the process—the military was given a 32 percent mission discount off an already artificially low commercial rate.

Design specifications that made the shuttle usable by the military and special pricing arrangements for Department of Defense payloads were actually less radical than they appeared. The military and civilian space programs have been intimately connected from the beginning. The relationship, an integral part of Air Force doctrine, was clearly articulated as far back as 1958. "At this point," said Under Secretary of the Air Force Malcolm A. MacIntyre, "it is premature to distinguish definitely between what research is primarily military and what is not." Major General Bernard A. Schriever, head of the Ballistic Missile Division, almost simultaneously echoed MacIntyre by insisting that he was unable to divorce military and civilian activities in space. Separating the two, he warned Congress, would breed costly and unnecessary duplication. For Schriever there was only one fundamental difference between the military and civilian space programs—military objectives were by definition more urgent.

The dimensions of the space shuttle's payload bay were largely dictated by the size of Air Force satellites.

ROCKWELL INTERNATIONAL

The B-57 crew had repeated this nuclear alert drill dozens of times. But today was different.

THE OPEN GATE

by Edwards Park

Illustrations by Will Williams/ Wood, Ronsaville, Harlin, Inc.

He lives now in an "adult community" on the edge of northern California's wine country in Sonoma Valley. It's a tree-shaded cluster of ranch-style houses on hilly lots where deer play, but not children. "Hell, if we saw a kid here we'd all die of shock," says Jim Mugavero.

You pronounce his name as though it started with "Mc." And if you knew him in the 41st Fighter Squadron in World War II, you'd call him "Mugs," and you'd wonder how he and his lively Australian wife can stand living in a place so quiet. He's no "adult." Overweight? Well, yes. Arthritic? Perhaps a bit. But he's still full of stories, and if you're lucky he'll tell you one.

Like the time he came face to face with World War III.

Mugavero made ace while serving in New Guinea and the Philippines, stayed in the recently established "blue suit" Air Force, and got to be a lieutenant colonel. In the early 1960s he had a cushy assignment at Andrews Air Force Base, just outside Washington, D.C. But he got fed up and put in for an opening someone at the Pentagon told him about: single-engine jet pilot with 2,500 hours; Yokota, Japan; family included.

He got the job—and found he'd been assigned to the Eighth Bomb Squadron of the Third Bomb Wing, which was based outside Tokyo. "It was a fine old outfit," he says. "But I'd never flown a bomber in my life. I'd never wanted to get *near* one!"

This was during the chilliest period of the cold war, and the Air Force had given this squadron a real doozy of a mission. Each of its 24 twin-jet B-57s had a specific target in the Asian Soviet bloc. If someone punched the button for code one—war—each B-57 would roar off at 500 mph and a 50-foot altitude carrying a single nuclear bomb. When it reached its destination, the B-57 would climb and, before going into a loop, release the bomb, which would climb still higher until it pitched over and descended to the target. The B-57 would continue the loop until it was headed away from the target in a shallow dive, inverted. The pilot would then roll upright, snuggle back onto the deck, and get out of there. "When it blew," Mugavero explains, "we hoped to be out of the blast area."

Rehearsing for this bit part in Armageddon was demanding, especially for young bomber pilots used to flying straight and level. The B-57, which had been designed in Great Britain as the Canberra and built in the States by Martin, was fine for surgical strikes, but it wasn't known for aerobatics. Putting one through an Immelmann (that half roll on top of the loop) was like wrestling

a steer to the ground. "That's why the Air Force had asked for a fighter pilot," says Mugavero, who would become squadron flight commander. "My job was to learn the mission and train the kids to do it without killing themselves."

In Japan, Mugavero eased into a routine of training flights and home life. He could help his wife with the shopping, see their three kids off to school, and come home and play with them in the evenings. Work consisted of flying to the practice bomb range, howling in at high speed and low to the target, beefing the nose up, and holding enough Gs to throw a phony bomb away from the airplane. The actual release was the task of a computer, which was activated by the pilot. "We never let it go," explains Frank Clark, who was the other half of the B-57's flight crew.

Clark was Mugavero's navigator, performing his role from the bomber's rear seat. A friendly and self-effacing bear of a man, too big to be a fighter pilot, he's taken the time to drive from Sacramento to reminisce with his former pilot. "While Mugs watched his gauges," Clark recalls, "I'd spot the horizon and tell him when to pull over the top of the loop. He was great to fly with, except when we had to practice dive-bombing. He'd head damn near straight down, and I'd yell, 'Pull out, pull *out*!' Gunnery I could take, and skip-bombing. But I hated those dives."

Every few weeks the squadron would leave Japan for a week or two on alert at Kunsan Air Base in Korea, south of Seoul, where they would relieve other crews. "We'd land at our base and roll into our revetments," says Mugavero. "Then the armament crews would 'upload' one nuclear bomb into each B-57."

At Kunsan the air crews stayed in a one-story wooden building that combined mess hall and dormitory. The aircraft were clustered outside; barbed wire fences enclosed building, airplanes, and men. A heavy chain link gate, which rolled on a track parallel to the fence, led to the runway and the great world outside: a flat landscape that was barren except for a mountain range at the horizon. Once the B-57s had arrived for the alert period, the gate stayed closed. Everyone knew that during this time it would open only for the real thing—a strike.

"As soon as we arrived at this Korean base, we'd get briefed on our targets," says Mugavero. They were different every time, and the men studied them carefully. They also played cards, used their new Japanese stereo equipment to tape music (a new group called the Beatles was getting hot), held endless bull sessions, and slept in their clothes while they waited for the bell.

"It would go off two or three times during the first days," Mugavero remembers. "I'd head straight for my plane, strap in, and get ready to start. Frank would grab our maps and orders from the operations officer and follow me. As soon as he got a hand on the cockpit ladder, I'd hit the switches." A black powder charge fired up the B-57's twin jet engines, and the crew was supposed to "show smoke" within five minutes of the bell.

That was all there was to it. The crews would fire up their airplanes, then shut them down. The targets were far away and there was no sense wasting fuel when every second in the air would count. The crews would then return to their quarters to wait for the next bell, when maybe they could improve their time. "Five minutes sounds long," says Mugavero, "but when you'd been waked up at 2 a.m. it really wasn't."

It was more like 4 a.m. when the bell went off one chilly morning in late November. Mugavero had been playing bridge the night before and was glad he'd retired early. He swung out of bed, downed some coffee, and yelled at Clark to move it so they could show smoke and get back into the sack. He trotted out to the airplane, scrambled into his seat, and clicked on his parachute straps. The auxiliary power had already been plugged in by the crew chief. Clark soon appeared, clutching papers. He climbed up the B-57's ladder as Mugavero prepared to turn the switches.

"Don't start!" shouted Clark.

"What the hell do you mean, 'Don't start'?"

"I mean don't start up. Not yet. This one's real. We can't waste fuel. We're on our way."

Mugavero stared at him. "You're kidding. Right?"

"I'm not kidding. We're on our way tonight. But don't start up until that truck moves."

Mugavero stared into the night and saw the impossible: the gate was open. An Air Force blue pickup truck had driven up and parked inside the gate. Its engine was plugged into an electrical heater to keep it from freezing and the driver stayed inside. "When he moves it, we take off for our target," said Clark, settling into his seat. "No one will tell us. We've got radio silence."

"What's happened?" Mugavero wondered aloud.

"I have no idea."

The two men sat silently, trying to keep warm in their winter flightsuits. As the hours passed they watched the sun brighten the sky. It might well be the last sunrise they'd see. Mugavero thought of his wife, who was probably just now waking. Soon she would be getting the kids up, starting breakfast, and planning a trip to the commissary. Thinking about it now, he searches for words: "The world was going on as usual right then, and there I was, waiting to end it."

Mugavero had seen his share of action. He knew that he and Clark would carry out their task. They'd make it to a certain unlucky spot on the maps that they had studied so closely. Then Mugavero would beef the yoke back at exactly the right second, hold exactly the right amount of Gs, wrestle the airplane through its half-roll, and then scream away from the great sun ball that would rise behind them. There'd still be fuel enough to make it back.

But to what?

"I remember thinking of swimming in the lake back in Michigan when I was a kid," says Mugavero. "I thought of things I'd always meant to do and never had. Mostly I thought about my family. As we sat there in our cockpit, Frank suddenly said, 'Jeez, I'd love a cheeseburger right now.' Remember that, Frank? I thought about that. Sure, we could have a couple of cheeseburgers when we got back. And then I thought, *No. No food. Nothing. Nothing left.*"

Maybe, he thought, *it would be better not to head back after throwing the bomb.* Clark could give him an accurate bearing for a desolate area, far from any civilization, where they might bail out, and they'd probably survive—for a while.

But why survive?

Sitting in their cockpit in the grow-

ing light of dawn, they listened to the radio's military channels and picked up the terse messages of Strategic Air Command bombers refueling in midair. "We knew those guys were on the edge, just like us, that one of their planes would also be hitting our target, that it would look like the Fourth of July there," says Mugavero. "I thought: *I don't want to do this, but I will. It's my job.* And I knew thousands of others were getting ready to do it too, on their side as well as ours. And I thought: *Nobody wants to do this. But we all will. Goodbye world.*"

And so it went, hour after hour, cramped in tandem seats, sitting on top of a would-be atomic holocaust, eyes ever on the pickup truck that would indicate launch verification when it moved out of the open gateway. "We had special things to consider," says Mugavero. "The plane, the fuel, the bomb, the course, the tactics—but I knew that really I wasn't a special person. I was as human as the next guy. I sat in that cockpit and had the same thoughts that anyone would have who knew that life—damn near *all* life—was about to end."

After six endless hours, an officer approached the B-57. He told Mugavero and Clark to shut down the electrical switches and come in.

The pickup truck started up and drove quietly away, trailing a little plume of blue exhaust. Mugavero and Clark watched the gate close.

The two men unbuckled their straps, pulled off their helmets, and clambered out of the Canberra. Standing beside it on the concrete taxiway, they rubbed the blood back into their numbed buttocks, stretching and flexing muscles, breathing deeply the cold Korean morning air. From all over the compound, pilots and navigators appeared, stiff, wan, weary, hungry, cold, scared.

All of them headed for the building, where they began unzipping their flying clothes. Once inside, a great chorus seemed to rise and echo: "What happened?"

A ground officer gave the answer quickly: President Kennedy had been assassinated.

In the great uncertainty that followed the deadly shots in Dallas, thousands of servicemen around the world had gone on alert. The end of civilization had been contemplated by many others besides Mugavero and Clark.

When Mugavero returned to Japan a few days later, his family was there to meet him. Driving home, his wife said, "I don't know if you heard the news about the president. He was shot and killed."

"Yes," said Mugavero. "We heard about it."

Wings, Women, and War

How will female pilots perform in combat? The answer may lie not in the future, but in the past.

by Reina Pennington

COURTESY INNA PASTORKINKOVA

Hardly anyone's image of a future fighter pilot as a child, Lilya Litvyak left little room for doubters when she flew with the Soviet Air Force over 50 years ago. She is credited with shooting down 12 enemy airplanes.

The German ace must have thought everything was in his favor on that September day in 1942. A senior pilot in the Richthofen Fourth Air Fleet and a three-time winner of the Iron Cross, he was flying over Stalingrad in skies ruled by the Luftwaffe. And the Soviet Yakovlev fighter attacking him had just run out of ammunition.

As the German pilot prepared to turn the tables, another Yak suddenly closed in and began an unrelenting assault. Despite his violent evasive maneuvers, he could not shake this Russian. The Yak-1 stitched his Messerschmitt Bf 109 full of holes, setting the aircraft on fire and forcing the pilot to bail out behind Red Army lines.

The German was captured and taken to the command post at the Soviet airfield of Srednyaya Akhtuba. There, some accounts say, he asked to meet the pilot who had shot him down; others say the meeting was his interrogator's idea, an attempt to persuade the German to talk. But when Junior Lieutenant Litvyak was presented to him, he assumed it was someone's idea of a joke. Standing before him was a petite, 20-year-old woman. He refused to believe he'd been beaten by this pilot, this *schoolgirl*, until Lilya Litvyak coolly related a blow-by-blow description of their engagement.

The idea of women combat pilots might seem strange to some people, but not to me. Women and flying always seemed a perfectly natural combination. I first remember flying when I was five years old. I didn't know the Piper Cub's pilot, but the copilot was my mother. I loved looking down on the patchwork fields near my hometown of Liberal, Kansas, where Mom was learning to fly with the Civil Air Patrol.

When I joined Air Force ROTC in 1976, I was told that women couldn't be combat pilots. My poor eyesight would have killed my hopes of military flying in any event. So I majored in Soviet area studies and spent my nine years in the Air Force as an air intelligence officer, working in fighter squadrons and finagling rides in every fighter, transport, and

SOVFOTO HAND COLORING THROUGHOUT BY ANTHONY A. DECARLO

helicopter that came my way. And if I was just a passenger, just glorified ballast, I never doubted that in another generation my daughter or niece could be flying in the pilot's seat. It didn't occur to me then that if I were Russian, it might be my *grandmother* who was the fighter pilot in the family.

I was writing a manual on the development of Soviet tactics when I first saw references to Soviet women flying combat missions during the second world war. Later I asked some analysts at the Defense Intelligence Agency about the wartime women's regiments. Most of them seemed to share the viewpoint of the author of a 1977 article, "Women in Combat," that appeared in *International Security* magazine; if the Soviets had women's aviation units, the author concluded, they were little more than an "exercise in public relations designed to impress the outside world." At the time, I had no reason to doubt him.

When I began searching for more information about Soviet women pilots, I soon found there wasn't much in English language sources. A few writers mentioned that Soviet women had flown in combat. Canadian historian Jean Cottam had translated a collection of memoirs by Soviet women pilots and written a few monographs. British writer Bruce Myles wrote an interesting (though fictionalized and undocumented) book called *Night Witches.* On the whole, little had been published in the West about Soviet women pilots, either during the war or after. If the Soviets had been trying to impress the West, they hadn't done a very good job of it.

I went to the Library of Congress and began examining the sources in Russian, which were more revealing. I found biographies and memoirs of Soviet women pilots. A search of wartime Soviet newspapers and journals revealed an occasional story or photo. More photos were in unarchived collections at the Smithsonian.

The official history of the Soviet Air Force acknowledged that there were three full regiments of women fliers during the war: a fighter regiment, a dive bomber regiment, and a night bomber regiment. I also found references in some of the Air Army histories, and in the memoirs of famous aviation generals. The diversity and nature of the references, the photographs, and the time span of the sources all indicated that the women's regiments were not mere propaganda but had really existed and fought.

Among all the stories, I found that of fighter pilot Lilya Litvyak the most compelling. Perhaps it was the tragedy of her short life: Litvyak was shot down at the age of 21, during one of the most horrendous air battles of the war. Perhaps it was the injustice of the lack of recognition for her achievements: she was a seasoned fighter ace and flight commander at the time of her death, with 12 personal kills and three shared kills. But, because her body couldn't be found, she did not receive the honors due her until many years after the war (see "The Search for Lilya Litvyak," p. 82). Somehow, for me, she came to symbolize all forgotten military women. Something about her became the theme for my research and drove me to continue.

Based on what I knew of the Soviet system, I didn't expect it to be easy to find and interview people. But things have

changed. After a few weeks of blitzing Moscow with questionnaires, which I sent to friends working in military archives, and having requests passed on by word of mouth, I began to receive responses from veterans of the women's regiments.

Polina Gelman was the first to answer. The thin envelope, decorated with a picture of red carnations, contained a small handwritten note and two typed pages. It was an incredible piece of luck: Gelman was one of the 30 women aviators who were awarded the Hero of the Soviet Union medal—the country's highest honor—during the war (and, as her husband proudly told a friend of mine, "the ONLY ONE Jewish woman in the world" to have been so honored). The gold star of the Hero could be awarded for a single courageous deed or for a consistent record of performance in combat. Gelman had been a navigator with the women's night bomber regiment—the "night witches," as they were called. She explained that she received the Hero in recognition of her 860 combat flights. Eight hundred and sixty times Gelman flew a fragile PO-2 open-cockpit biplane into combat, bombing enemy positions, performing reconnaissance, and dropping supplies to troops.

COURTESY VALENTINA PETROCHENKOVA NEMINUSHCHAIA

Nearly all the flights were at night.

I had seen a picture of Gelman taken in 1946 in Red Square. Posed between two women from her regiment, Gelman was half a head shorter than the others. Ironically, before the war she initially had been denied permission for air club pilot training because she was so short. "They were afraid that in difficult situations, for example in a spin, my feet wouldn't be able to reach the pedals," she wrote. "In the air club where this happened, there is now a flagstone that bears the names of Heroes who were once members of the club. Among those names, and the only woman's name, is mine."

Gelman was one of the many thousands of young Soviet women who sought to learn how to fly in the 1930s. One out of every three or four pilots trained in sport clubs was a woman. Still, there's a big difference between sport and combat flying, even when, like Gelman, you used the same aircraft—the PO-2—for both.

Why did the Soviets decide to allow women to fly in combat when other countries, such as the United States, only permitted them to perform support duties? Was propagan-

COURTESY ALEXANDER GRIDNEV

da the reason? Soviet women had full legal equality; was that interpreted as an equal right to serve? Either way, the Soviets would have made contingency plans to mobilize and train women for war. But the Soviet government apparently had no pre-war plans to use women in combat positions, much less to create women's flying regiments.

In their published memoirs as well as their letters to me all the women said the same thing: the Soviet Union did not tell them to fight or even ask them to fight. The women themselves *demanded* to fight, and it took many months before the government agreed. Every woman I interviewed reported trying to join the army soon after the Germans invaded the Soviet Union on June 22, 1941. But at first, the Soviet military wouldn't have them.

"A woman doesn't want to be hidden behind some man's back during difficult times," Irina Rakobolskaya wrote to me. A former navigator and the chief of staff of the women's night bomber regiment, Rakobolskaya is now a professor of physics at Moscow State University. I had written to her in California, where she was visiting her son—also a professor of physics, at Stanford University. She took time out from her vacation to write me a long letter—five large sheets of unlined paper, covered front and back with small, neat, almost vertical handwriting. She apologized for not having a Cyrillic typewriter handy; I would have been grateful if she'd written in crayon on paper napkins.

Rakobolskaya was a senior physics student at the university when the war broke out, but she immediately volunteered for combat duty. "At the start of the war, they only took into the Army those women who already had specialties like medicine and communications," she wrote. Rakobolskaya began studying nursing at night—anything to get to the front.

Inna Pasportnikova, who eventually became Lilya Litvyak's mechanic—what we might call a crew chief—found herself in a similar situation. Pasportnikova was a third-year student at the Moscow Aviation Institute when the war began. "I applied repeatedly to be sent to the front," she recalled. "But it was to no avail. They suggested that I get training to become a nurse or a medical orderly."

I'd read somewhere that Pasportnikova's hands are disfigured from the burns, fuel spills, and frostbite she endured as a wartime mechanic. Yet she sent handwritten letters of many pages, as well as helped me to acquire copies of unpublished memoirs, official documents, poems, songs, and many of Lilya Litvyak's letters.

It was not until October 1941 that Pasportnikova had the chance to become a soldier. "The telephone rang at midnight in the Komsomol committee at the Institute. They called us in the dormitory and told us that the famous pilot, Hero of the Soviet Union M. M. Raskova, was forming a women's aviation unit," she wrote. "There was a curfew in Moscow at the time and it was forbidden to move around the city at night. We had to wait until morning, or else we would certainly have run on foot through the night to the place where the organizing commission was working." It seemed like a bolt from the blue.

Pasportnikova didn't know that Raskova had worked many months to persuade the Soviet government to form women's aviation regiments. Attractive and serious, her dark hair always in a bun, Marina Raskova was a famous navigator who participated in many record-setting flights during the 1930s. She and two pilots were the first women to be awarded the Hero of the Soviet Union medal (and the only ones to receive it prior to the war), when in 1938 they completed a harrowing Moscow-Far East flight that broke the international women's distance record. Stalin himself presented the medal.

Many of the women veterans believe that Raskova used her influence to make a personal appeal to Stalin. Soon after the war began, Raskova had formally petitioned the Soviet Air Force to set up women's regiments, but a decision was delayed for months. At that time, there was no military need for additional pilots. The Soviet Air Force had taken a terrible beating in the first few months of war; between June and September, some 7,500 Soviet aircraft were lost. But many of them had been destroyed on the ground. In October the Soviets had far more pilots than airplanes. It seems unlikely, then, that it was military desperation that led to the creation of women's aviation regiments. In fact, it's astonishing that the Soviets decided to allocate *any* precious aircraft to the women.

COURTESY ANNE NOGGLE

Given the circumstances, it seems most likely that it was the weight of Marina Raskova's fame and influence, perhaps backed by Stalin's personal interest, that persuaded the Soviet Air Force to create women's regiments. Once permission was granted, events moved rapidly. They had to: the German offensive on the Soviet capital, Operation Typhoon, began on September 30. By early October the situation was grave.

Raskova was authorized to form a temporary aviation group, the 122nd, for the purpose of training women pilots, navigators, mechanics, and armorers. From the 122nd, three combat regiments would be formed: the 586th Fighter Aviation Regiment, the 587th Dive Bomber Regiment (later giv-

Only the best qualified women pilots were assigned to combat flying duties. Valentina Petrochenkova (opposite, top), a pilot with the 586th Fighter Aviation Regiment, had been a flight instructor before the war. Others were trained as mechanics (left) and navigators, such as Hero of the Soviet Union Polina Gelman (above).

SOVFOTO

en the honorary designation of 125th Guards Bomber Aviation Regiment), and the 588th Night Bomber Regiment (redesignated the 46th Guards Bomber Aviation Regiment).

Polina Gelman was working with other university students digging anti-tank ditches outside Moscow when she heard that a women's aviation unit was being formed. She submitted her paperwork the next day. Rakobolskaya heard only that young women were being asked to volunteer for some sort of military job, and she made her decision instantly. "Who needed physics when the Germans were at the gates of Moscow?" she wrote. "I knew nothing about the fact that they were recruiting for aviation. I just wanted to fight."

Because thousands of women had been trained as pilots before the war, there was no shortage of volunteers for the women's aviation unit. The main difficulty was that virtually no women had been trained as navigators or mechanics. As a result, the only women who became military pilots were those with the highest flying qualifications—women who had been instructors in the air clubs or who had flying experience in civil or military aviation. Of the remainder, those with the highest level of education were enrolled as navigators. The rest who were accepted, including many pilots, became mechanics, armorers, or staff personnel.

Lilya Litvyak was one of the women serving as instructor pilots when the war began. She had always wanted to fly. Her sister-in-law, Lyubov Orifieva, wrote to me, "When Lilya was fourteen she secretly began to attend the air club. At first they wouldn't admit her, so she eavesdropped behind the door. The watchman chased her out. But she had a dream from her early childhood. She used to say, 'I'm going to be a pilot and a captain.' "

Eventually Litvyak was admitted to the air club and went on to advanced training as an instructor pilot. She trained 45 students before the war began. Like the other women, Litvyak applied repeatedly for military duty when the war started. She had been ordered to stay with her air club, which was being evacuated to the rear, and continue to train pilots. At the last minute she learned about Raskova's group. After being accepted, she donned a man's uniform many sizes too large for her and kissed her mother and brother goodbye.

On October 16, within a week after the initial announcement, the entire 122nd Temporary Air Group boarded a train and traveled 500 miles to the town of Engels, north of Stalingrad. They spent the next few months at the Engels Aviation Institute. After initial flight training, Raskova made assignments: each pilot was assigned to fighters, day bombers, or night bombers, and each navigator was assigned to a regiment.

The 586th Fighter Aviation Regiment was the first to receive its complement of combat aircraft, the Yak-1 fighter, and became operational in April 1942. It was assigned to the Air Defense Forces, with the mission of protecting strategic fixed targets. The night bomber regiment was next to go on active duty, in May 1942; it was equipped with PO-2 open-cockpit biplanes. The dive bomber regiment was held up until January 1943, due to an abrupt change of aircraft. The dive bomber crews had trained on the two-seat Su-2 but at the last minute were allocated the demanding three-seat Pe-2 dive bomber instead. The regiment had to wait for additional training and personnel.

In September 1942, one squadron from the 586th was detached to augment two front line regiments at Stalingrad. The group included a total of eight women pilots, together with their mechanics and armorers. Among them were Lilya Litvyak, Katya Budanova (another pilot who achieved ace status), and Inna Pasportnikova. Pasportnikova remembered that they received their transfer orders on September 10. On the 13th, according to archival documents, Litvyak scored her first two victories, becoming the first woman in the world to shoot down an enemy aircraft.

"The situation both on the ground and in the air at Stalingrad was extremely intense," wrote Pasportnikova. "Endless columns of enemy aircraft bombed the city. The city was burning; for many kilometers the thick smoke overshadowed the sun." The air battles were furious. The Soviet Air Force had suffered heavy losses at Stalingrad during

the summer. When the women arrived at the battle-weary regiment, the male pilots were skeptical of their abilities (though they were quick to make use of their aircraft). "Several of them did not want to fly in the same group as the women on combat missions," Pasportnikova recalled. "It was even more difficult for us, the mechanics: they could not accept us at all."

The women fighter pilots had to prove their abilities in order to earn the respect of the men. It was difficult enough for a woman like Budanova, who was the type that is kindly called "strapping." For Litvyak, it must have been virtually impossible; she was tiny, blonde, and stunningly beautiful. But though Litvyak had trouble gaining professional respect on the ground, she quickly set the pace in the air. Inna Pasportnikova remembered the day of Litvyak's third mission at Stalingrad, when she achieved her first two kills: "Lilya was the wingman to the regimental commander. They spotted three Junkers 88s to the side of a bigger group of bombers. The leader decided to attack; Lilya followed his lead. She attacked so energetically that the bombers scattered and dropped their bombs. Taking advantage of this, her leader shot down one Ju 88, while Lilya killed a second."

But the battle wasn't over. Litvyak spotted her friend, Raya Belyaeva, attacking a Bf 109. But Belyaeva ran out of ammunition. Litvyak engaged the Messerschmitt and shot it full of holes. Shortly after, she found out its pilot was the highly decorated—and unbelieving—German ace. For a pilot newly arrived at the front to achieve two kills in a single day—one against a fighter ace—was a rarity. And Litvyak did it at Stalingrad, where, as Pasportnikova noted, "the numerical superiority of the enemy aircraft was indisputable."

If the women flying with male regiments faced antagonism, Rakobolskaya recalled that the fliers of her all-female regiment also initially had some problems with male attitudes. But "after the first six months of the war," she wrote, "we always felt that the male pilots and the commanders treated us with respect."

The consensus seems to be that at first the men were skeptical and often tried to "protect" the women aviators by attempting to keep them from flying. Gelman remembered an informal but intense effort among the crews in the 46th night bombers regiment to fly the most missions. On average, the women flew five to seven missions a night; Gelman recalls one night when she made 17 sorties. Men who were based at the same airfield jokingly tried to persuade them to slow down. "They said, 'The less you fly, the longer you'll live,' " Gelman told me. "But our regiment held first place in the Air Force for number of flights."

The reason the night bombers were able to make so many flights had to do with the nature of their mission. The outmoded PO-2 biplane they flew was so vulnerable to enemy fire that it could not be flown near enemy lines during the

As part of the crew of the Rodina, *navigator Marina Raskova (opposite, at right) earned national recognition. Later she was instrumental in the formation of the women's regiments.*

Major Alexander Gridnev gives a preflight briefing to pilots under his command; today he is concerned that their valor was not justly recognized.

COURTESY ALEXANDER GRIDNEV

day. It had a top speed of less than 100 mph and a limited range and so was normally based on makeshift airstrips right at the front lines. At night, the PO-2s flew frequent, relatively short missions against front line targets such as troops and unit headquarters.

The 46th also achieved a record number of flights because it stayed on combat duty for three solid years, from May 1942 to May 1945. "Without a single break, in the course of three years, without rest or leave, I flew an average of five to ten combat flights a night in the fire of ground batteries and in the blinding beams of searchlights," wrote Gelman. Rakobolskaya also reported that while most regiments took occasional breaks from combat duty, the 46th never did.

The women apparently had to prove themselves to each new group of men. In late October 1942, Litvyak and three other women were transferred to another fighter regiment. Pavel Golovachev (later a major general of aviation and two-time winner of the Hero of the Soviet Union medal) wrote about their arrival in a 1963 collection of war memoirs. "Quite often one or another would ask to be wingman to the most experienced male fighter pilots, especially young Lilya Litvyak. She appealed to many, including me. And we, every time, politely refused. Personally, to me it would have been unbelievably difficult to go through the death of such a wingman in combat. And after all, a woman!"

In this case, the men may not have wanted to "protect" the women as much as avoid risking the blow to masculine pride that the death of a female partner might inflict. After all, when the men refused to take women as wingmen, it didn't keep the women from flying in combat. They simply flew together, rather than with the more experienced male pilots. Only after the women demonstrated their skill did some of the male pilots agree to fly with them.

Litvyak and Budanova had a similar experience when they were transferred again in January 1943. When they arrived at the new air division, the staff had to decide which regiment they would be assigned to. Boris Yeryomin (later lieutenant general of aviation) commanded the reconnaissance regiment in that division. When he was asked to take the new pilots, he refused. Yeryomin wrote in his memoirs, "I could not even mentally imagine that I would send these girls into the rear of the enemy—and indeed if they ended up in my regiment, they'd have to fly reconnaissance. Sometimes it's difficult to keep from being nervous when awaiting the return of an experienced air ace, upon whose shoulders are a hundred combat flights.... And now I would have to send girls on such missions.... It wouldn't sink into my head, and so I firmly decided: let them be offended, let them consider me an unfeeling fellow, but our regiment conducts too specific a combat mission, and therefore I could not take the girls."

His reluctance was not based on any doubt of the women's ability; Yeryomin later commented that Litvyak "was a born pilot. She had, I would say, a special talent for fighters, was capable and decisive, inventive and wary." Pasportnikova still works with Yeryomin in a veterans' group. She wrote, "Personally I believe that Yeryomin acted correctly: he very much wanted to preserve their lives. But, to the great regret of all who knew them, the war directed otherwise."

As time passed and the number of casualties rose, the issue of whether men and women could work together in combat became critical. The 586th fighter regiment and 125th dive bomber regiment began to receive male replacements. There just weren't enough women trained to fill some of the

Although highly skilled, fighter aces Litvyak and Katya Budanova (below, left and center) repeatedly had to prove themselves to their male colleagues.

Commissar Vera Tikomirova (opposite) monitored the 586th's politics—a duty that must have been largely a formality in a group of passionate volunteers.

SOVFOTO

command and technical positions. Perhaps too, after Marina Raskova died when her airplane crashed in January 1943, the Soviet Air Force lost the impetus to train women for the regiments that flew more modern aircraft.

The 46th night bomber regiment remained entirely female throughout the war, "from the regimental commander down to the electrician," as Rakobolskaya noted. The veterans of this regiment are particularly proud of that. In one of Gelman's letters to me, she typed out in all capitals: "OF THE THREE WOMEN'S REGIMENTS FORMED FROM THE 122ND AVIATION GROUP, ONLY THE 46TH GUARDS...REMAINED PURELY FEMALE UNTIL THE END OF THE WAR." Beside the paragraph, she wrote by hand: "Important!"

COURTESY ALEXANDER GRIDNEV

When the first commander of the 586th fighter regiment, Tamara Kazarinova, was forced to leave in October 1942 (officially, for health reasons), a man, then-Major Alexander Gridnev, took her place. Wartime photographs show a rather handsome, dark-haired man with a strong, John Wayne sort of nose. "I arrived at the 586th, as they say, 'with a noose around the neck,' " Gridnev wrote me. Not because he didn't want to be there—at that point he was glad to be anywhere. He had been a commander of a fighter regiment when the war began, but in August 1941 he was arrested by the NKVD (later the KGB). The charge was sabotage: another pilot accused Gridnev of attempting to sabotage a mission in which the head of the NKVD was flying. Although he was later cleared of the charges, few Air Force commanders were willing to take him on at that point. When he was assigned to the 586th, it seemed to him a haven.

Compared to the other units, the 586th fighter regiment received relatively few awards. One possible reason is that for most of the war it was relegated to air defense duty, defending fixed targets rather than seeking out the enemy. It also flew many missions to escort transport aircraft flying VIPs in the battle area: at various times the 586th provided escort for such people as Nikita Khrushchev and Marshal Georgi Zhukov. In general, there were fewer opportunities for heroism in the 586th than there were in front line units. Gridnev feels, however, that the lack of recognition for the unit's accomplishments was due to a lingering ill will toward him on the part of some influential people.

The unit's pilots certainly chalked up achievements that warranted the Hero award. In the spring of 1943, two pilots of the 586th, Tamara Pamyatnykh and Raisa Surnachevskaya, were scrambled on alert. When they reached the target area, they discovered 42 German bombers. Gridnev was in the command post. "What was there to do?" he wrote. "I got on the radio and commanded them, 'Attack!' "

Attack they did. Driving a wedge into the German formation, the pilots managed to scatter the bombers, forcing them to drop their bombs well short of target. Moreover, each woman shot down two enemy bombers. The target of the German attack, a rail junction loaded with Soviet troops and fuel supplies, was unscathed.

"Some representatives from Great Britain saw all of this," wrote Gridnev. "They reported it to the King of England, and he sent the girls inscribed gold watches. But our own people never even found the time to give them the Hero. I believe this is one of the most distinguished victories of the entire war. They should hang two gold stars on each of them for this."

Although the pilots who remained with the 586th for the duration of the war did not receive the Hero, many other women did. Pilots accounted for 32 of the 92 Hero medals awarded to women for wartime valor, although the two or three hundred women aviators made up a small fraction of the 800,000 women who served in the Soviet military. The 46th night bomber regiment was truly exceptional. "Usually there were two or three Heroes in a regiment, but we had 23," noted Rakobolskaya. "There was no men's PO-2 regiment in which there were so many Heroes of the Soviet Union." When I asked her why the 46th achieved such a record, Rakobolskaya provided a simple explanation: "The title of Hero was conferred by law if a pilot or navigator completed more than 500 successful combat flights. Our Heroes, as a rule, had more than 700 flights." In addition to the number of Heroes received, an indicator of the quality of the women's service was the redesignation of two of the regiments with the honored "Guards" title.

Was there any difference between the performance of the women fliers and that of the men? Everyone I interviewed seems to agree on one thing: women flew at least as well as men. Gelman wrote that "the women, compared to the men, were very scrupulous about the fulfillment of each mission." Rakobolskaya said, "The women flew no worse than men, and in many respects better...after all, they were not required to serve. And that which is done at the call of the heart is always done better than that which is done out of obligation."

While many of the women were reticent about their performance, Gridnev was pragmatic. "Our experience showed that women fighter pilots bore G-loads and various non-standard situations better than the men; for example, G-loads during 360-degree turns, and exits from spins. They also had greater endurance during high-altitude flights without oxygen." He later told me about pilots like Raya Belyaeva and Evgenia Prokhorova, who were "a head higher than the men in all matters. There was never a man who could keep up

The Search for Lilya Litvyak

SOVFOTO

Litvyak was the first woman in the world to shoot down an enemy aircraft—a fact not yet officially recognized in her home country.

Lilya Litvyak was something of a maverick. From the time she sneaked into air club classes as a teenager and told her parents she was attending drama club meetings, she usually managed to have things her way. Her given name was Lidya, but she chose to go by Lilya instead. Even in the active Air Force—the Soviet Air Force, to boot—Litvyak followed her own mind.

Inna Pasportnikova, Litvyak's aircraft mechanic, first noticed the pilot at a morning formation during the early days of the women's regiment training at the Engels Aviation Institute. Litvyak was called out of the ranks by Marina Raskova, the unit commander. The reason was evident: Litvyak had removed the usual brown collar from her uniform and replaced it with one of white fur cut from her boot linings. Raskova asked, "Litvyak, what have you got around your neck?" "A goatskin collar," she replied. "Why, doesn't it suit me?"

Pasportnikova recalls that even at the front, Litvyak continued to stand out. "At one time it was the fashion to draw frightening designs on the aircraft—the mouths of snakes, tigers, or lions. I asked Lilya, 'What should I paint for you?' She said, 'Flowers.' "

Litvyak loved a challenge. She had scarcely returned from being hospitalized with a leg wound when she took on the mission of destroying a German observation balloon. The balloon was used to direct artillery fire and had proven to be devastatingly effective. "Our male pilots had made several attempts to destroy the balloon," says Pasportnikova, "but a solid wall of artillery fire prevented them from breaking through." Litvyak tried a different tactic. "She flew deep into our territory, then crossed the front line where the enemy did not expect it. She approached the balloon from the rear, out of the sun, and remained unnoticed. She shot up the balloon at point-blank range on the first attempt."

Whenever she returned after shooting down an enemy, Litvyak would swoop around the airfield, performing strictly forbidden victory rolls and high-speed, low-altitude passes. On the ground, regimental commander Nikolai Baranov (called "Father" by the pilots) would stand and curse at her. "After her circus number in the air, Lilya always asked me, 'Did Father swear terribly?' " Pasportnikova recalls. "And if I said, 'Terribly!' she would hang her head and walk over to him with her post-mission report." But Litvyak continued with her ad hoc airshows each time she made a kill.

Though Litvyak was a daredevil, she was also out to prove something. In 1937 her father had been arrested during Stalin's purges and vanished into the gulag. Pasportnikova says that Litvyak never stopped believing in her father, but his arrest cast a cloud over the family name: "By her victories, she wanted to prove her devotion to the Motherland."

According to both Pasportnikova and Litvyak's sister-in-law, Lyubov Orifieva, the pilot's greatest fear was that she would be classified as "missing without a trace." Anyone who disappeared in combat could be listed under that awful epithet, which carried with it the suspicion of desertion and betrayal. Tragically, that is precisely what happened to her.

On August 1, 1943, Litvyak's Yak-1 regiment was fighting over the Donbass region on the southern front. Litvyak had already flown three sorties that day, shooting down a Messerschmitt Bf 109 on the third. On her fourth flight, her group of nine Yaks encountered a large flight of German aircraft—30 Junkers Ju 88 bombers escorted by 18 fighters. While attacking a group of bombers, Litvyak was jumped by a pair of Bf 109s that approached out of the sun. Her wingman, Alexander Yevdokimov, saw her descend into the clouds and thought she might have made an emergency landing. Another pilot, Ivan Borisenko, attempted to follow her down but could find no sign of her: no explosion, no parachute, nothing.

Litvyak's aircraft went down in enemy-held territory. A report circulated that a woman in a flying uniform was seen riding in an open car with Germans, but few people believed this was Litvyak.

"I was long tormented by the question of how to prove that Lilya was killed heroically and did not turn out to be in captivity," Inna Pasportnikova recalls. "There was only one possibility: to find her remains. And I vowed that I would do this while I lived."

It was a quest that would last nearly 50 years:

- Mid-August 1943: Litvyak's regiment, the 73rd Guards Fighter Aviation Regiment, nominates her for the Hero of the Soviet Union medal, but the higher command refuses to approve the award until her body is discovered.
- Summer 1946: I. Zapriagaev, commander of the 73rd, sends people to search for Litvyak's aircraft near the spot where she disappeared. It is not found.
- 1946–1968: Through letters and newspapers, Inna Pasportnikova establishes contact with several groups

of schoolchildren in "Octobrist" and "Pioneer" groups who live in the Donbass region. Such children's groups often help search for unmarked graves, aircraft wreckage, and other war relics: they spend summer vacations following up reports of crashes and digging by hand to find relics.

• 1968: The newspaper *Komsomolskaya Pravda* revives the appeal to award Litvyak the Hero of the Soviet Union medal. Soviet Air Force headquarters informs the paper that her body still must be found before the award can be made.

• 1971: Young Pioneers from Middle School Number One in Krasny Luch in the Donbass become the main participants in the search for Litvyak. Inna Pasportnikova and members of her family participate in several of the summer searches. In all, more than 90 aircraft are found, as well as the remains of many unidentified pilots.

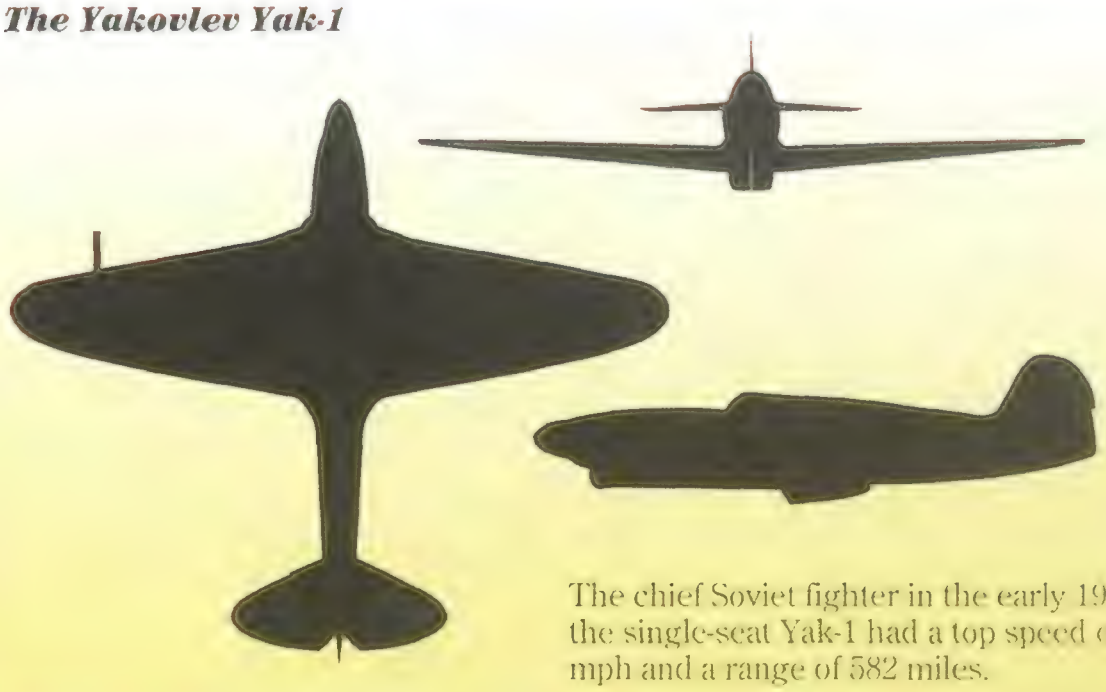
• 1979: The Pioneers find a crash site on a farm near Dmitrievka and are told that a woman pilot had been buried there but then moved in July 1969 to a common grave. The body is exhumed. The doctors can tell only that the pilot had been a short woman and had sustained a head injury. The schoolchildren determine that since the crash occurred in the Eighth Air Army's area and there was only one woman fighter pilot from the Eighth missing during that time, the body must be Litvyak's.

• March 31, 1986: Information from the Central Archives of the Ministry of Defense confirms that the woman pilot who crashed near Dmitrievka had to be Litvyak.

• 1988: Litvyak's name is placed on the common grave. The Ministry of Defense approves the changing of her records so that she is no longer listed as "missing without a trace" but is now "killed in action, 1 August 1943." A plaque is placed on Middle School Number One naming it for the pilot.

• May 5, 1990: Chairman Mikhail Gorbachev signs a document conferring the title of Hero of the Soviet Union on Lilya Litvyak.

The Yakovlev Yak-1



The chief Soviet fighter in the early 1940s, the single-seat Yak-1 had a top speed of 373 mph and a range of 582 miles.

An armorer with the 586th loads cannon shells for one of the regiment's Yak-1 fighters (below). Each Yak was armed with one cannon and two machine guns.

with Belyaeva in a maneuvering fight; they blacked out trying to out-turn her."

When asked whether the women's regiments were primarily used for propaganda, the women were either angered or mystified by the question. "They wrote a lot about us during the war in the front line newspapers," Rakobolskaya noted. But she pointed out that "at first, they gave us men's last names. It was like the regiment was classified secret. Later on, when we became Guards and the first Hero was awarded, they began to write more." It seems that far from being a propaganda sham, the women's regiments received what publicity they did because of concrete accomplishments.

"Crews from other regiments reported on our results, as did ground reconnaissance. It was easy to verify everything: the number of combat flights, of bombs dropped, of rounds fired," Gelman wrote. Rakobolskaya reminded me of the number of women Heroes, adding: "It would have been impossible to award a title like Hero simply for propaganda reasons." Several of the women alluded to all the women fliers who died. As Gelman emphasized, "After all, girls were killed; how could this have been propaganda?"

Even in Russia, the accomplishments of the women's regiments are not well known today. Virtually all the newspaper and magazine articles that have been published there appear only in March, in connection with International Women's Day. Many Russians have never heard of the women's regiments. Except for Litvyak, the women fighter pilots seem virtually unknown.

This may have been due to

COURTESY ALEXANDER GRIDNEV (2)

The Soviets' wartime coverage of the women's regiments tended to emphasize stereotyped female behavior, an approach embodied in these obviously staged photos (above and left). Ironically, even as these women were proving themselves the equals of men as pilots, the legal status of women in Soviet society during the war was regressing. By the time the war was over, women in the Soviet Union had lost ground.

Inna Pasportnikova, Litvyak's wartime mechanic (opposite, small photo), remains devoted to the memory of her friend; in a recent photo (far right), Pasportnikova and the author pose by a portrait of the pilot.

Stalin's heavy-handed pro-natalist campaign after the war. The women's regiments were demobilized, along with the bulk of the Soviet Air Force. Although a few women remained in military aviation (primarily as test pilots or air traffic controllers), the vast majority of women veterans were discharged and sent home to work—and make babies. Mother Russia may wield a sword, but in the other arm she usually cradles a child.

In 1945, Soviet president Mikhail Kalinin told a group of demobilized women soldiers, "Do not talk about the services you rendered." Scholars of Soviet education found that after the war information about military women was removed from texts and lectures; even post-war Soviet novels played down or omitted women soldiers as characters. By the 1950s women were prohibited from entering Soviet military academies. Since women could no longer become soldiers, there was no reason for the government to glorify what its women soldiers had done in the past.

The late Vladimir Lavrinenkov, former colonel-general of aviation and twice Hero of the Soviet Union, flew with Litvyak and Katya Budanova at the front. In his 1983 memoirs, he says, "How rarely do we recall the names of the women fighter pilots! There weren't many of them, but their combat actions deserve the very highest appraisal. They disproved the erroneous opinion that the profession of air combat is unacceptable for women. Katya Budanova and Lilya Litvyak were, for us, dependable comrades-in-arms."

The women I corresponded with were glad to be remembered. "It is so remarkable that in far-off America, after fifty years, it is interesting and important to someone to find out about us," Rakobolskaya wrote. I was immensely grateful that they had taken so much time to tell their stories to me, but I regretted that I had not been able to speak to them in person. Then, unexpectedly, an opportunity to go to Russia for the annual reunion of the three women's aviation regiments came along and through the generosity of friends and family, I was able to attend.

The gathering was held on May 2 in Moscow, in the park in front of the Bolshoi Theater. The day before, right-wing extremists had sparked a violent riot in the city; the day of the reunion was beautiful and peaceful. There were fewer veterans than usual, I was told; some were unable to attend because of the different currencies now used in the former Soviet states. Death had also taken a toll. Still, they came, some shuffling or walking with canes, and they sat with their old comrades and remembered the war.

During my visit, I met and re-interviewed every woman quoted in this article, as well as General Yeryomin. I obtained copies of hundreds of pages of official records of the regiments from the military archives. I visited the Military History Institute, where they insisted on interviewing *me* ("Tell us about the discrimination against women in the American military," I was asked. "Is it true that women are paid less than men?").

Inna Pasportnikova and I went to Volgograd; Colonel Gridnev himself came to meet us at the train station. He seemed greatly diminished from his wartime photos. Yet when we talked, he spoke forcefully, peering at me intently, blue eyes beneath bushy brows, over the rim of his spectacles. Gridnev is dedicated to setting the record straight.

Later, Inna and I stood together on the east bank of the Volga River, at dusty Srednyaya Akhtuba—the airfield where Lilya Litvyak made her first two kills. "It hasn't changed at all," said Inna. A tall woman with soft white hair, she shook her head in disbelief. "The grass was dry and brown instead of green. But it was just like this. There wasn't a single bush here, only stickers and tumbleweeds. They brought water out to us on camels, you know." She smiled, paused a moment, and pointed: "The command post was there. That's where they took the German ace that Lilya shot down."

More than 50 years have passed, and now many governments are reevaluating the role of women in the military. Canada, France, and, more recently, the United States have opened combat aviation to women. Some people still don't think that wings, women, and war are a good mix. But then, they didn't know Lilya Litvyak—or the other Soviet women who flew.

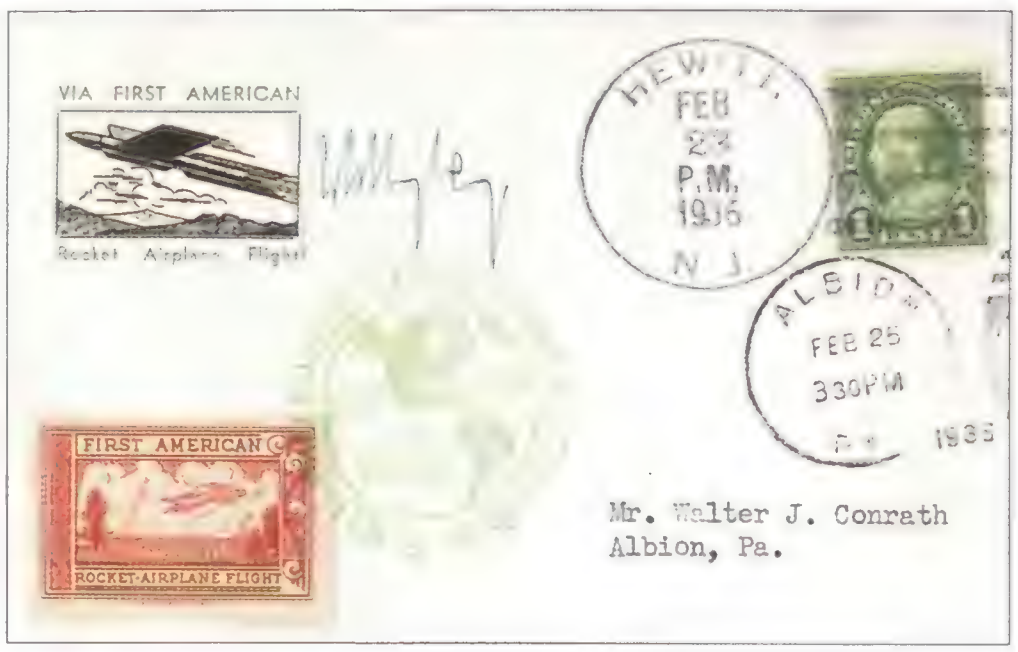
COURTESY INNA PASPORTNIKOVA

COURTESY REINA PENNINGTON

Posthaste

One afternoon in February 1936, hundreds of spectators gathered on frozen Greenwood Lake, an hour northwest of New York City. Police kept them at a distance from a handful of figures standing farther out on the ice. At the center of the privileged group was a large sloping ramp about 10 feet high. At the bottom of the ramp was a miniature airplane. Suddenly the others backed away, and science writer Willy Ley, dressed in white and holding a torch, hurried to the ramp. A rocket-mail flight was about to be launched.

COURTESY STAN SOLOMON (2)



Two years previously, New York City stamp dealer Frido Kessler had visited Germany and had been fascinated by the stamps that had been used on mail carried by recent pioneer rocket flights in Europe and India. In 1931, Austrian engineer Freidrich Schmeidl's V-7 rocket had carried 102 pieces of mail from Mount Schoeckel toward the village of Radegund. In Great Britain in 1934, Gerhard Zucker of Germany demonstrated that a solid-fuel mail rocket could be recovered and reused, and the following year he attempted the first rocket-mail flights from Belgium across the English Channel. Neither rocket reached the coast of England but both were recovered by ships.

When Kessler returned home he produced a catalogue of stamps from these flights, and finding a healthy market among collectors for rocket-flown mail, he decided to sponsor a U.S. flight.

Learning that Kessler was seeking a launch site, J.G. Schleich, an avid stamp collector and Greenwood Lake official, suggested his village, which sits on the New Jersey border. Kessler could fire the rocket, stuffed with cards and envelopes purchased by collectors, from New York to New Jersey, where the Hewitt post office would postmark and process the cargo.

Overseas experimenters had used conventional rockets with gunpowder packed in a long tube with a cone-shaped nose and stabilizing tail fins. Kessler's craft was markedly different: it was an aircraft rather than a rocket, and used liquid fuel. The duralumin high-wing glider had rectangular wings attached midway down its 12-foot body, providing a 15-foot span. A squared-off vertical stabilizer jutted from the top aft fuselage and mated to a rectangular horizontal stabilizer. Except for the graceful curve of the lower fuselage, the craft had not the slightest suggestion of streamlining. It resembled a giant version of a crude free-flight model airplane.

"The wings were solidly built," says Dave MacMillan, a trustee of the New Jersey Aviation Hall of Fame, "but they used hardware store materials like simple sheet metal screws to attach them." The rocket plane's builders also used hardware store materials for the propulsion system, which provided some 60 pounds of thrust when liquid oxygen and gasoline were pressure-fed into the combustion chambers by gaseous nitrogen. Pulled from its socket, a long metal rod activated a spring-loaded trigger that opened a valve, releasing the nitrogen and allowing the fuels to flow, mix, and build up pressure. Ignition required holding a torch to the stream of gases shooting from the exhaust pipe, and launch required releasing the counterweight, a barrel of sand, from the top of the ramp. The barrel yanked a cable that slung the airplane up the ramp and into the air.

Kessler commissioned three rocket planes, designed by Alexander Klemin, an aerodynamicist at New York University's Guggenheim School of Aeronautics, and all named "Gloria" in honor of Schleich's daughter, who would christen them on

launch day. Kessler's newly formed Rocket Airplane Corporation distributed flyers announcing the "first interstate rocket mail delivery." Collectors could order either a 75-cent envelope or a 50-cent postcard, many of which were autographed by Kessler and Ley.

Aviation was a hot topic in 1936, and the media loved the novelty of a rocket-powered airplane, particularly since rocket enthusiasts foresaw 29-minute flights from New York to Paris. Sunday supplement stories sacrificed accuracy for hype. "People discussed how the rocket would travel at 500 mph and land on the roof of the Hewitt post office," says Wilbur Christmann, a former Greenwood Lake mayor.

On February 9, spectators, photographers, and reporters turned up at the lakeshore community. It was bitterly cold—cold enough to freeze the champagne Kessler had brought to christen the Glorias and cold enough to seal Greenwood Lake with a foot of ice. "They brought this thing out, tried to light it, and nothing happened," says Christmann, who was on hand that day. "Finally, around four, when they were losing daylight, they announced they would try again the following week."

Two weeks later it was still cold, but 200 people trooped onto the ice. Newsreel photographers set their clumsy cameras on tripods, police shooed spectators back, and newsman Robert Trout prepared to do a live radio report.

The crew pulled the safety, the fuels began to mix, gases raced from the exhaust, and Ley, in an asbestos safety suit, applied the torch. The first Gloria raced up the ramp and crashed to the ice. With its motor roaring and blue flame shooting from the exhaust, it slid across the lake until it became airborne. Fifty feet in the air, it headed for the newsreel photographers, who "grabbed their cameras and ran like crazy," says Christmann. Then the Gloria's wings suddenly folded and it dropped to the ice.

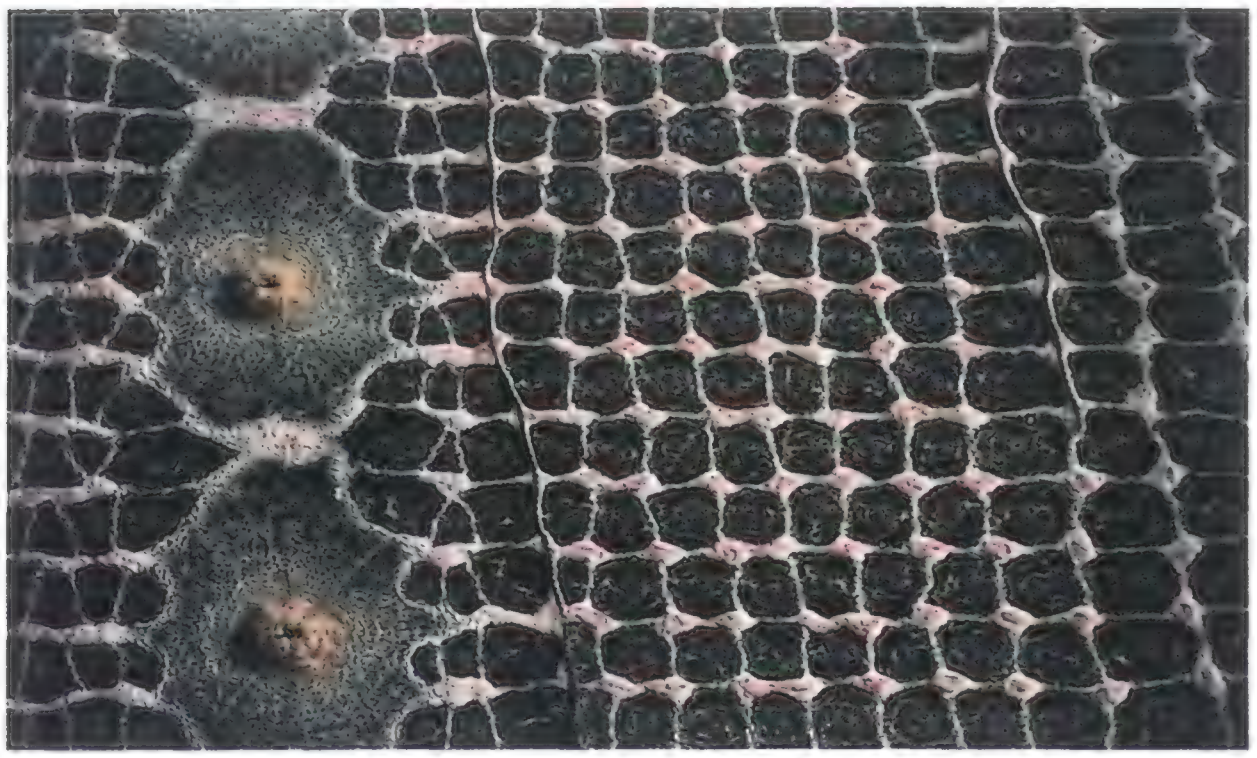
Undaunted, the rocketeers brought out the second Gloria. This time they launched directly off the ice, perhaps, as Dave MacMillan suggests, for expediency's sake. The rocket plane raced along the frozen lake and clawed its way into the air. It was gaining altitude when its wings crumpled and it too dropped to the ice. According to MacMillan, although the designers had braced the rocket planes' wings to prevent them from collapsing downward, they had not anticipated that in-flight stress would cause them to fold up.

Did the second Gloria cross the state line? That depends on which newspaper you believe. One account asserts that someone kicked the craft across the border before opening it and handing the mail sacks, stuffed with some 6,000 cards and envelopes, over to the Hewitt postmaster. (Today, cards autographed by Ley command up to $75.)

Pat Reilly, executive director of the New Jersey Aviation Hall of Fame, points to the May 1936 issue of *Popular Mechanix*, which features a rocket plane on its cover. The accompanying article states that despite the short distance traveled, the two Glorias proved that a rocket motor could lift and propel an aircraft many times its own weight and maintain stability. (The third, which never flew, will soon be exhibited at the New Jersey Aviation Hall of Fame.) As late as 1952, the assistant postmaster general speculated that mail-carrying missiles were "just around the corner." Although Kessler gave up on his rocket-mail experiments, he did achieve a minor place in history for himself and an otherwise inconspicuous lakeside village.

—Stan Solomon

To Look for America



ALEX MACLEAN

A papermill's aeration basin creates a foam lattice across the Connecticut countryside.

Look at the Land: Aerial Reflections on America. *Photographs by Alex MacLean, text by Bill McKibben. Rizzoli, 1993. 176 pp., $50.00 (hardcover).*

As a student at the Harvard Graduate School of Design, Alex MacLean began to study the land from the air while flying his Cessna 182. In 1975 he formed Landslides, an aerial photography company, and over the years he has produced many beautiful photographs. As his new book indicates, however, he is after more than just "pretty pictures."

The problem with aerial photography—unfortunately even good aerial photography—is that so much of it looks the same or elicits the same response in the viewer. The best pictures always seem to rely on patterns or geometric shapes. And after you have seen a dozen or so images of the quilts that cover the earth, you are not really anxious to see many more. *Look at the Land* offers more than a repetitious sequence of aerial landscapes. Thanks to MacLean's informed captions and *New Yorker* writer Bill McKibben's lucid text, the images are accompanied by an insightful narrative; the result is a kind of aerial photojournalism, rich with meaning and information.

The way to view this book is exactly the way MacLean and McKibben intend: by examining how things fit together. What is revealed is not only a glimpse of how the planet works, but also a look at how humanity interacts with its biosphere. In its synthesis of art and information, *Look at the Land* offers a new and provocative portrayal of the United States.

—Declan Haun has worked as a photographer and photo editor for Life, National Geographic, *and many other magazines.*

To the White Sea *by James Dickey. Houghton Mifflin, 1993. 275 pp., $22.95 (hardcover).*

"I was more sure than ever, now, that I had to get to Hokkaido," concludes tail gunner Muldrow in James Dickey's third novel, *To the White Sea*. Muldrow's B-29 has been shot down over Tokyo, hours before the Allies bomb the city. Raised as a solitary hunter on Alaska's Brooks Range, he decides his only hope is to wait out the attack in a sewer, escape the city in the ensuing panic, and journey to the enemy's northern island, where he can find "the kind of cold that cleans out your insides like fire."

Dickey, who flew over 100 missions as a fighter pilot in World War II and Korea and wrote the 1970 bestseller *Deliverance*, evokes both the chaos of burning Tokyo and the pitch of battle above like someone who's been there: "Another fighter showed.... He fired again, and was in range, and hit us a little somewhere up the fuselage.... He fired again, and this time he was on his curve. I led what I figured was two rads and cut loose. Nothing happened. I waited a second, until I judged he was point-blank line astern and below, and cut loose again, all three seconds.

"The whole sky lit up."

Muldrow makes it out of the city. Homing north by the constellation Polaris, he walks, jumps a train, commandeers a truck, and steals a boat until he reaches the shores of Hokkaido. All the while he leaves a trail of butchered corpses. He kills out of necessity and convenience, for a coat or pair of shoes, for a bag of feathers, for the splinters of bone in an old man's arm that he'll fashion into sewing needles. He casually recalls a girlfriend in Alaska whom he strangled. Why, we never learn.

Wherein lies the biggest problem with the book. While *Deliverance* drew its power from Ed Gentry's forced evolution from a suburban businessman on a canoe trip to a woodsman who survives by learning to think like a predator, Muldrow already *is* a predator and, apparently, always has been. Accordingly, his journey is one of miles only; as a character, he remains stuck in place, and the reader is left a bystander to a brutal tale for which he or she can feel very little.

—Glenn Wiser is a paralegal and writer in Silver Spring, Maryland.

This year, give the gift of spellbinding action and discovery!

A gift of *AIR & SPACE/Smithsonian* is one that definitely won't end up on some forgotten shelf.

Every issue of this big, one-of-a-kind magazine comes brimming with vividly authentic adventures into the realm of flight and the mysteries of space!

The official publication of the Smithsonian's renowned National Air and Space Museum, *AIR & SPACE/Smithsonian* is a feast for both the eye and mind.

Every feature a strikingly graphic presentation!

No other magazine affords such realistic visits to the exciting world of pilots, astronauts, and aerospace scientists—such vividly stirring adventures to the highest frontiers.

AIR & SPACE/Smithsonian re-creates for those to whom you give it the epic flights of famed air and space craft of every type, every era. It even details how man will one day explore other worlds and reach out for contact with alien intelligence.

More than a subscription—a multi-part gift!

When you give *AIR & SPACE/Smithsonian,* you also give membership in the National Air and Space Museum at no extra cost!

With benefits like discounts on flight-related and other merchandise, and eligibility for exciting events scheduled throughout the nation by the Museum, as well as by the Smithsonian itself, membership alone would make for an exciting gift.

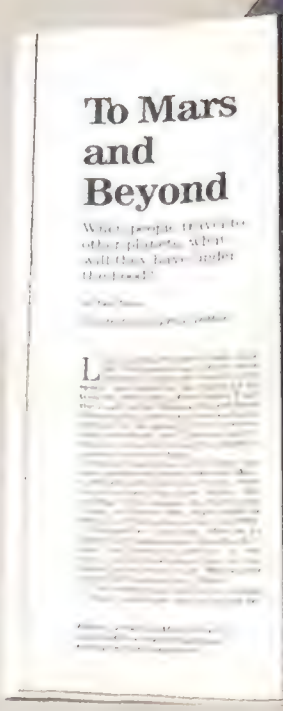
How to give all this, and save money too!

A gift of *AIR & SPACE/Smithsonian,* including Museum membership and benefits, actually costs substantially less than the newsstand rate for the magazine by itself.

In short, it's not only a genuinely attention-getting remembrance, it's a very affordable one as well.

Send your favorite people this uncommon multi-part gift simply by completing and returning the coupon. We'll bill you later.

NOTE: ORDER YOUR GIFT SUBSCRIPTION NOW! To assure timely delivery, we must receive your order as quickly as possible.


To Mars and Beyond

Use this form to order your gift subscription *today!*

AIR&SPACE Smithsonian

HOLIDAY GIFT ORDER FORM

Please enter the person named below as a subscriber to *AIR & SPACE/Smithsonian* for six bi-monthly issues—*and* as a member of the National Air and Space Museum for one year.

Gift To:

NAME

ADDRESS

CITY STATE ZIP

Your name and address here:

MY NAME

ADDRESS

CITY STATE ZIP

☐ Bill me ☐ Payment enclosed ☐ Enter a subscription for me

MY TOTAL ORDER: _____ gift subscription-memberships (including my own if checked above) at $18 each total $_____.

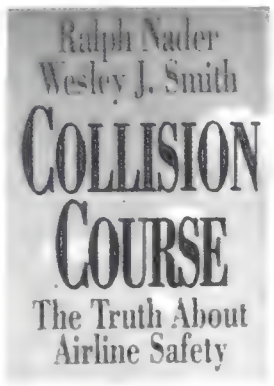
NOTE: Outside USA add $6 for each foreign order. Payment must be made in U.S. funds. (85% of dues is designated for magazine subscription.)

MAIL TO: AIR & SPACE/Smithsonian, P.O. Box 53261, Boulder, CO 80322-3261

2X3H3

Collision Course: The Truth About Airline Safety *by Ralph Nader and Wesley J. Smith. McGraw-Hill, 1993. 378 pp., $21.95 (hardcover).*

The stated goal of *Collision Course: The Truth About Airline Safety* is to examine current issues and trends affecting aviation safety as seen by those who work in the field. In their quest, co-authors Ralph Nader and Wesley Smith address a wide array of topics, including aging aircraft, management and funding problems of the Federal Aviation Administration, obsolescence of air traffic control equipment, safety of commuter airlines, crash survivability, human factors, and terrorism. It's an ambitious undertaking and, perhaps inevitably, only partially successful.



Collision Course is at its best when uncovering problems within the FAA. The discussions of the shortcomings in the agency's inspection programs and the problems and delays in its rule-making process are well done and on target. Similarly, the ways that economic deregulation has affected the challenges the FAA faces are clearly described.

Instead of striving for a reasoned conclusion after looking at both sides of an issue, however, the authors prefer to assume the role of a prosecutor presenting a case and seeking a villain. For example, the discussion of a proposal to rehire the fired PATCO air traffic controllers is remarkably one-sided and ignores a wealth of conflicting information. Moreover, the authors are so preoccupied with air traffic controllers that they overlook the far more serious shortage of technicians qualified to maintain the aging air traffic control equipment.

Regrettably, the book also contains some inaccurate statements and others that are potentially misleading for those not familiar with the issues. Thus, some alleged safety problems are overstated, while others may not receive the attention they deserve. *Collision Course* is interesting and thought-provoking reading, but it should not be the reader's only source of information on this important topic.

—Clinton V. Oster is a professor at the School of Public and Environmental Affairs, Indiana University.

NEW FROM SMITHSONIAN INSTITUTION PRESS

Carrier Warfare in the Pacific: An Oral History Collection, *edited by E.T. Wooldridge, foreword by John B. Connally. 309 pp., b&w photos, $24.95 (hardbound).*

The Great War in the Air: Military Aviation from 1909 to 1921 *by John H. Morrow Jr. 458 pp., b&w photos, $29.95 (hardbound).*

Queen Bess: Daredevil Aviator *by Doris L. Rich, afterword by Mae Jemison. 153 pp., b&w photos, $18.95 (hardbound).*

Storm Over Iraq: Air Power and the Gulf War *by Richard P. Hallion. 383 pp., b&w photos, $24.95 (hardbound).*

Through a Universe Darkly: A Cosmic Tale of Ancient Ethers, Dark Matter, and the Fate of the Universe *by Marcia Bartusiak. HarperCollins, 1993. 383 pp., b&w photos, $27.50 (hardcover).*

Having pried open the heavens by examining every wavelength and nuance of light, astronomers now concede that the great bulk of the universe—perhaps 90 to 99 percent of its mass—has escaped their detection, by virtue of being dark and different from the familiar matter that shines.

"The luminous stars and galaxies could be mere whitecaps, whose gleaming presence diverts our eyes from a hidden ocean of matter right below," writes Marcia Bartusiak in this clear and confident chronicle of modern astronomy. What is most striking about the book is its ability to span centuries as interstellar matter evolves from ether to space-time. No less impressive is how women astronomers emerge in these pages—their struggle told without rancor—as though they constituted another form of dark matter that had never been really recognized until viewed in the light of a new and deeper understanding of the history of astronomy.

Bartusiak has such an enviable grasp of the big picture that she is able to communicate the inherent drama so that the reader gets caught up in the dark mystery. Taking her title from the New

Testament's Corinthians ("For now we see through a glass, darkly"), Bartusiak recalls Genesis and countless other creation myths by dividing her book into two parts, "Light" and "Dark." Here, the Light is the truth as astronomers have gathered it. The Dark is their drive to learn the rest—the current hunt by astronomers and particle physicists for a pervasive entity whose size, distribution, and nature are utterly unknown. In both parts, Bartusiak manages to be accessible without being pedantic, and the book as a whole proves immensely satisfying—despite the fact that the story is, perforce, unfinished at this writing.

—Science writer Dava Sobel is co-author (with Frank Drake) of Is Anyone Out There? *(Delacorte Press, 1992).*

CURATOR'S CHOICE

Target America: The Soviet Union and the Strategic Arms Race, 1945-64 *by Steven J. Zaloga. Presidio Press, 1993. 368 pp., $24.95 (hardcover).*

This is fascinating reading because it's the first complete account of the Soviet threat from its inception to its demise that is based on Russian sources. Highly recommended!

—Gregg Herken is chairman of the space history department at the National Air and Space Museum.

JG 26: Top Guns of the Luftwaffe *by Donald L. Caldwell. Orion Books, 1991. 440 pp., b&w photos, $25.00 (hardcover).*

"Horrido, dicke Autos," crackled a voice over the radio. As the name of St. Horridus, the patron saint of German hunters and fighter pilots, was evoked at the sight of the "fat cars" or enemy bombers, the feared fighters of the JG 26 dove out of the sun to begin their attack against Allied heavy bombers entering the Reich. The fascinating operational history of World War II's famed Jagdgeschwader (Fighter Wing) 26 "Schlageter" (named for a German nationalist martyr) is told for the first time by an American author. Based on earlier German unit histories, memoirs, and records of the German and Allied air forces, *JG 26: Top Guns of the Luftwaffe* offers one of the few balanced portrayals of the German side of the air war.

Led for a time by Adolf Galland and including many other aces of the Luftwaffe, the unit fought throughout the war and ended with an amazing 2,700

aerial victories, a ratio of better than three to one against its opponents. Its losses were heavy: 763 pilots killed or missing and 67 captured. More than 300 pilots were wounded in combat and another 100 injured in accidents. The unit fought on all major fronts but served mostly as a defensive force on the western front.

The author's research is impressive. The book includes countless names and engagements, detailed accounts of equipment, and excerpts drawn from official histories and diaries, as well as interviews with the surviving pilots. Since the focus is on the unit's history, there is little analysis of the totality of the war, but a feeling for war is powerfully conveyed.

The easy victories of the earlier years eventually gave way to a bloody struggle in the middle period and finally a sharp decline beginning with the Allied command of the air in the early months of 1944. German pilots were not rotated after a certain number of missions; they were either killed, wounded, or moved to a desk job. The psychological toll was devastating. Nearly all of the experienced pilots lost were replaced by green pilots who never had a chance. The qualitative and quantitative edge the Luftwaffe had enjoyed was gone, yet they fought on. Their history was a microcosm of Hitler's war and *JG 26: Top Guns of the Luftwaffe* is an engrossing and worthy contribution to the history of the air war.

—Edward L. Homze is a professor of history at the University of Nebraska at Lincoln.

TELEVISION

The Military Channel, which is scheduled to premiere on cable on January 16, 1994, will feature an aviation documentary series called *Flight.* Hosted by Jeffrey Ethell, a leading aviation author (and *Air & Space/Smithsonian* contributor), the series will present in-depth views of the world's advanced tactical aircraft. Check local listings for more information.

CREDITS

Power Play. Alex Nelon, who lives in Hendersonville, North Carolina, wrote "Happy Trails" for the February/March 1993 issue of *Air & Space/Smithsonian.*

Ski Edwards! Milton O. Thompson, chief engineer at NASA's Dryden Flight Research Facility at Edwards Air Force Base, died last August at his home in Lancaster, California. He is the author of *At the Edge of Space: The X-15 Flight Program* (Smithsonian Institution Press, 1992).

Life After Eastern. Henry Scammell is the author of *The Arthritis Breakthrough* (M. Evans Publishing, 1993) and the co-author of *Bones: A Forensic Detective's Casebook* (HarperCollins, 1992).

Further reading: *Freefall,* Jack E. Robinson, HarperCollins, 1992.

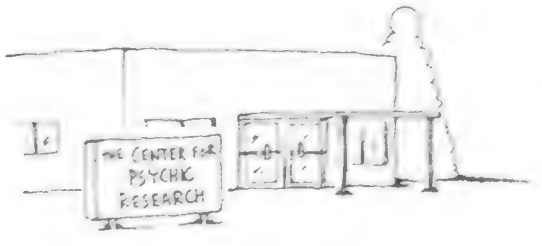
Blundersat. Frank Kuznik is a frequent contributor to *Air & Space/Smithsonian* who now files his stories from Chicago instead of Washington, D.C.

Further reading: *Satellite Remote Sensing: An Introduction,* Ray Harris, Routledge & Kegan Paul, 1987.

One Hundred Minutes to Freedom. David Savold is an associate editor at *Air & Space/Smithsonian.*

Further reading: *Wings of the Morning* by Orestes Lorenzo, to be published in January by St. Martin's Press.

Combat Comics. Hal Higdon, a freelance writer from Michigan City, Indiana, was a finalist in NASA's journalist-in-space program.



The Smithsonian Traveler

The Latest Word on Study Tours, Seminars and Research Expeditions

For free catalogs and brochures, write Smithsonian Study Tours and Seminars, 1100 Jefferson Dr. S.W., Washington, D.C. 20560, or call (202) 357-4700. More than 250 learning adventures are offered in 1994, including:

Ship Models (Annapolis, Maryland) April 15-17: Learn about the Age of Sail and see exquisite ship models at the U.S. Naval Academy.

The Cold War (Albuquerque, New Mexico) April 19-23: Meet distinguished American and Russian historians and scientists. Join exclusive tours of Los Alamos and White Sands Missile Range.

New Astronomies (Tucson, Arizona) May 15-21: Visit the Smithsonian Whipple Observatory and National Observatories at Kitt Peak.

Anniversary of D-Day in France June 2-12: Visit the landing beaches and attend official commemorative events. Includes Bayeaux, Giverny museums.

Statement of ownership, management, and circulation (required by 39 U.S.C. 3685) of *AIR & SPACE/Smithsonian*, published bimonthly at the Smithsonian Institution, 900 Jefferson Drive, Washington, DC 20560 for October 1, 1993. General business offices of the publisher are located at 900 Jefferson Drive, Washington, DC 20560. Name and address of publisher: Ronald C. Walker, 900 Jefferson Drive, Washington, DC 20560. Name and address of editor: George C. Larson, 370 L'Enfant Promenade, SW, 10th Floor, Washington, DC 20024. Known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages, or other securities: None. The purpose, function, and nonprofit status of this organization and the exempt status for Federal income tax purposes have not changed during preceding 12 months (Section 411.3 DMM). The average number of copies of each issue during the preceding 12 months are: (A) Total number of copies printed: 380,500; (B) Paid circulation: (1) Sales through dealers and carriers, street vendors, and counter sales: 21,812; (2) Mail subscriptions: 321,100; (C) Total paid circulation: 342,912; (D) Free distribution by mail, carrier, or other means: 9,743; (E) Total distribution: 352,655; (F) Copies not distributed: (1) Office use, left-over, unaccounted for, spoiled after printing: 2,249; (2) Return from news agents: 25,596; (G) Total: 380,500. The actual number of copies of single issue published nearest to filing date are: (A) Total number of copies printed: 373,186; (B) Paid circulation: (1) Sales through dealers and carriers, street vendors, and counter sales: 23,669; (2) Mail subscriptions: 307,412; (C) Total paid circulation: 331,081; (D) Free distribution by mail, carrier, or other means: 11,198; (E) Total distribution: 342,279; (F) Copies not distributed: (1) Office use, left-over, unaccounted for, spoiled after printing: 1,426; (2) Return from news agents: 29,481; (G) Total: 373,186. I certify that the statements made by me are correct and complete.
Carey O. Randall
Associate Publisher, Administration

CREDITS

Securing the High Ground. William E. Burrows is the founder and director of New York University's graduate Science and Environmental Reporting Program. His books include *Deep Black* and *Exploring Space.*

The Open Gate. Edwards Park flew a P-39 in New Guinea during World War II. He is a frequent contributor to *Air & Space/Smithsonian.*

Further reading: *Canberra: The Operational Record,* Robert Jackson, Smithsonian Institution Press, 1989.

Wings, Women, and War. Reina Pennington is a former Air Force intelligence officer and Soviet analyst who served with the Aggressor squadrons. She is now completing a Ph.D. in Russian history.

Further reading: *Night Witches,* Bruce Myles, Academy Chicago Publishers, 1990.

Posthaste. New York City high school teacher Stan Solomon would like to be reincarnated as an airmail pouch so as to spend as much time as possible in an airplane.

A Safe Harbor. Gerald Fitzgerald is a Washington, D.C. writer who travels frequently to Ireland.

CALENDAR

December 11–January 23
"All Systems Go: America's Space Transportation System for the 1990's." Smithsonian Traveling Exhibition. Carnegie Science Center, Pittsburgh, PA, (412) 237-3400.

January 4–22
"Apollo to the Moon." One-man multimedia performance about one young man's dream of becoming an astronaut. Recommended for young people grades 3–7. Discovery Theater, Arts and Industries Building, Smithsonian Institution, Washington, DC, (202) 357-1500.

January 16
"Open Cockpit Sunday." World War II and modern fighters, helicopters, DC-3 transport. New England Air Museum, Bradley International Airport, Windsor Locks, CT, (203) 623-3305.

"The Satellite Sky" Update/39

These regular updates to "The Satellite Sky" chart will enable readers to keep their charts up to date. Additions can be clipped and affixed to the chart at the appropriate altitude.

New launches

90 to 300 MILES

- Cosmos 2262 9-7-93 TT
- Cosmos 2264 9-17-93 TT
- Progress M-19 8-10-93 TT

300 to 630 MILES

- Alexis 4-25-93 Pegasus
- Cosmos 2263 9-17-93 TT
- Eyesat 1 9-26-93 KOU
- Healthsat 1 9-26-93 KOU
- Itamsat 9-26-93 KOU
- Kitsat 2 9-26-93 KOU
- Meteor 2-21 8-31-93 PL
- Posat 1 9-26-93 KOU
- Spot 3 9-26-93 KOU

- Stella 9-26-93 KOU
- Temisat 8-31-93 PL

6,200 to 13,700 MILES

- GPS-22 8-30-93 CAC

21,750 to 22,370 MILES

- ACTS 9-12-93 KSC
- Fleetsatcom F/O 9-3-93 CAC
- Raduga 30 9-30-93 TT

DATA: SAUNDERS KRAMER

Deletions

90 to 300 MILES

Resurs F-19 down 9-10-93

Launched but not in orbit

90 to 300 MILES

Cosmos 2260 CIS photo recon	7-22-93	down 8-5-93
ORFEUS FRG research	9-12-93	down 9-22-93
STS-51 U.S. research	9-12-93	down 9-22-93

Inoperative but still in orbit

300 to 630 MILES

NOAA-13

21,750 to 22,370 MILES

Olympus 1

FORECAST

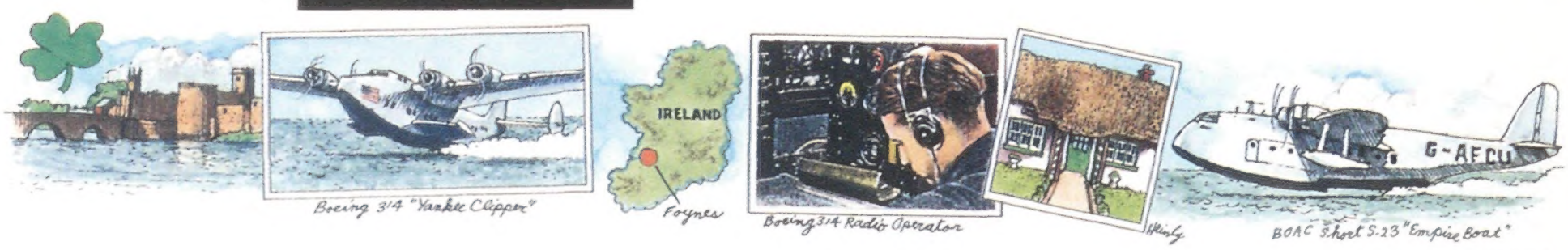
In the Wings...

The Tragedy of Captain Glen Stewart. Five years ago, a British Airways pilot botched a 747 instrument approach to Heathrow. On his second try, he landed routinely. That first mistake led to his death.

Mars Direct. When George Bush set the nation's sights on Mars, NASA told him it would take 30 years and cost $400 billion. And that, NASA said, was *after* the space station was built. Bob Zubrin thinks he has a better idea.

Life With the General. James Harold Doolittle (1896–1993) was an aviation legend best known for his daring bombing raid on Tokyo and his leadership of the Eighth Air Force in Europe. But the author of this brief memoir knew him best as "Gramps."

Do You Know Michael Minovitch? In 1974, Mariner 10, a spacecraft headed for Mercury, demonstrated that the best means of traveling between two points in space is not following a straight line. The man most responsible for the gravity assist technique is today an unsung hero.



Boeing 314 "Yankee Clipper" · Boeing 314 Radio Operator · BOAC Short S.23 "Empire Boat"

JOHN HEINLY

A Safe Harbor

On July 5, 1937, an S.23 Empire flying boat named the *Caledonia* took off from the River Shannon at the village of Foynes, Ireland, and set out for Newfoundland. Just a few hours later, another flying boat, the Sikorsky S-42B *Clipper III*, headed out on the reverse trip. The official purpose of the flights was to survey the transatlantic route for commercial service, but more to the point, the flights were intended to prove that the big craft could make the journey at all. Both flights were successful: the *Caledonia* flew the 2,000 miles in 15 hours, while the *Clipper III*, aided by the prevailing winds, did it in twelve and a half. Within two years, both airmail and commercial passenger service began on the north transatlantic route.

Exactly half a century later, Ireland honored those pioneer flights, as well as later flying boat history, by opening the Foynes Flying Boat Museum. The facility, which is located 25 miles from Limerick, occupies what was once a terminal for the seaplanes' passengers.

On a recent visit to the museum, I was met by curator Margaret O'Shaughnessy (she pronounces her name "o-shock-nessy," the Irish way). O'Shaughnessy explained that in 1935, Canada, Britain, and the Irish Free State formed the Atlantic Company, which would provide air service between Europe and North America. Because landplanes did not then have sufficient range, the company would use flying boats. The harbor town of Foynes was chosen as the service's western terminal.

Soon the village had a new pier and a meteorological service. An airport radio was installed in the railway station, next to the quay, and the Monteagle Arms Hotel was converted into an office building for the airport manager, the weather service, customs, and the airlines that would operate the flying boats—Imperial, Pan Am, and, in 1940, American Export. Imperial (which later merged with British Airways to form BOAC) provided a restaurant. Then a control tower was added on the village's main street, and finally the passenger terminal.

On entering the museum, it becomes clear that Foynes was once a place of some importance, though not recently: development of aircraft with longer range soon made flying boats obsolete, and the Foynes terminal closed in 1945. But the museum brings the airport's heyday to life with evocative interior detail—the plain, rounded design of the fixtures, the 1940s-era tearoom, with its little café-style tables, and, on the wall behind the ticket counter, summer 1940 schedules for transatlantic flights.

Foynes Flying Boat Museum, Foynes, County Limerick, Ireland. Phone (069) 65416. Open 10 a.m. to 6 p.m. March 31 through October 31 and by appointment the rest of the year. Admission £2.50; discounts for children, seniors, and family groups.

The museum has restored the terminal's radio and weather room; on display are the original Marconi medium- and long-wave transmitter and receiver, as well as a Morse code generator. The room also has an ancient dome-shaped radio, which once played tunes that cheered and diverted a world at war. And in the building's period-style movie theater, a short film, *Atlantic Conquest*, is shown in four languages.

The natural centerpiece for the museum, of course, would be an actual flying boat. But few are left; currently, the Foynes museum has its eye on a couple of Catalinas, as well as a Japanese replica of a Sunderland.

Luckily, the pilots who flew the craft can still vividly recall the experience. The people at Foynes led me to one, an American named Jim Waugh, who started his 40-year career with Pan Am on flying boats. Flying the craft, Waugh explained, required more than good piloting techniques; it required maritime skills. During landing or takeoff, Waugh sometimes felt as if he were on a sailboat.

The wings of the Boeing B-314s were built with spaces that allowed the crew to make adjustments to the engines during flight. But Waugh remembers crew members crawling into the wings for another reason: "Going down a narrow channel with an offshore wind, we'd all go as far out as we could get on the high wing to keep the low one from dragging the water." Laughing, he adds, "Then, of course, they would turn around, and we'd run over to the other side."

During the war, the pilots faced more dire challenges. In those years, most of the flying boats traded company colors for suits of camouflage paint. The passengers changed as well. Though Ireland remained neutral, between September 1942 and December 1943 four out of five visas stamped at Foynes belonged to American or British military personnel.

The museum has identified many who passed through Foynes in those years. During my visit, O'Shaughnessy opened a large notebook and read from a letter written in 1989 by Howard Fry, a BOAC pilot who often stopped at the base on his way to Lisbon in neutral Portugal and then to West Africa:

"One night, I think in 1943, two other flying boat captains and I were waiting for it to get dark enough for the flight across the Bay of Biscay to Lisbon. I should explain that we normally took off at last light, so we would not be easily spotted by German long-range fighters. As we were about to board the launches to take us out to the flying boats...the Irish airport commandant came hurrying down the quay.

" 'I would not be going, gentlemen, if I were you,' he said. We were rather put out. 'We have to go,' we told him. 'Then I'll have to spell it out for you,' he went on. 'Hasn't the lighthouse keeper at Loop Head just phoned to say that a German fighter is circling the lighthouse waiting for you.' [Later,] when we came to thank the commandant profusely for his help, he replied in a way which was characteristic of so many Irishmen at the time. 'Well, boys,' he said, 'some of us are not as neutral as we're supposed to be.' "

—Gerald Fitzgerald

PLANET EARTH
A COMMEMORATIVE EARTH DAY POSTER FROM THE APRIL 1990 SMITHSONIAN

The Poster measures 21¾" x 28¾"
Printed on Recycled Paper
Allow 4 to 6 weeks for delivery

Send $5.00 with address to:
Smithsonian Magazine, P.O. Box 23624,
Washington, D.C. 20026-0624

UP TO
$1,000
A YEAR
OR MORE
toward a new GM car or truck.
Plus all the advantages
of a Gold MasterCard.®

This Isn't Just A Caribbean Cruise. It's A $322 Bonus.

It's your dream vacation, and you've already earned a $322 bonus toward a new GM car or truck. Just by using your new GM Gold MasterCard and GM Travel Services.℠

Here's how: Every time you book travel through GM Travel Services using Preferred Suppliers like Delta Air Lines, Delta DREAM VACATIONS,℠ Royal Caribbean Cruise Line,® Club Med® and many others, you get the 5% GM Bonus, plus a 5% Partner Bonus. **Up to $1,000 a year or more!** After you've reached the $1,000 level, you keep on getting the 5% Partner Bonus. There's no limit to the savings with GM Travel Services and their Preferred Suppliers. And there's no charge for the GM Travel Services feature of The GM Gold Card.℠

The GM Gold Card.℠ Don't Spend More, Spend Smarter.℠

To apply, call **1-800-846-2273.**

Offer is redeemable as discount on purchase or lease of a new GM car or truck. Up to $1,000 annually, or maximum of $7,000 over 7 years. No limit on Partner 5% Bonus during 7-year period. May be combined with other offers. Subject to GM Gold Card Rebate Program Rules. Based on travel expenses of $3,220 using GM Gold Card Partners. GM Travel Services provided by Carlson Travel Group, Inc.